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UNIVERSITY OF SHKODRA "LUIGJ GURAKUQI"
FACULTY OF EDUCATIONAL SCIENCES

Department of Psychology and Social Work

Scientific Research Competition
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Field of study: Social Psychology

"Cyberbullying Dynamics in the Western Balkans: Victimization, Perpetration and Bystander Intervention"

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Abstract

The dynamics of cyberbullying were examined among young people aged 18 to 22 in six Western Balkan countries (Albania, Kosovo, North Macedonia, Montenegro, Serbia, and Bosnia and Herzegovina) (n = 1066). Using a quantitative methodology, the analysis identified gender differences in four subdimensions of cyberbullying perpetration and victimization (public humiliation, malice, unwanted contact, deception), as well as the interaction between aggressive bystander intervention and severity of perpetration and levels of victimization. Multivariate analyses did not reveal any statistically significant effects of gender on cyberbullying behaviors. However, men reported higher levels of perpetrating unwanted contact and deception, while women reported perpetrating higher levels of public humiliation and malice. Also, a strong positive correlation was found between aggressive bystander intervention and severity of cyberbullying perpetration ($r = .834$, $p < .001$), and severity of victimization suggested 53.6% of the variance in aggressive bystander responses ($R2 = .536$, $p < .001$).

Keywords: *cyberbullying, Western Balkans, victimization, crime perpetration, bystander intervention.*

1. Introduction

Cyberbullying is a major concern among young people (Prroni & Reçi, 2025). One aspect of this challenge is the uncontrolled dissemination of information through the media, which not only causes collective anxiety among parents about their children's online safety (Keyzers & Dworkin, 2023), but also inadvertently provides cyberbullies with new methods to perpetrate abuse. Traditional bullying has evolved into a comparable problem, mediated by screens and algorithms, as technology improves.

Cyberbullying involves a wide spectrum of negative behaviors, starting from abusive language, anonymous harassments on the phone to the unwanted sharing of personal information and threats. These activities cause psychological harm, particularly to social cognitive and behavioral functions (Walters, 2021). Teenagers should not be exposed to social media without proper parental supervision, but the fact that this rule is not respected by individuals who may not be well-informed about technology leads to risks such as cyberbullying.

Erikson's developmental theory (1950) provides insights about the effects of cyberbullying on young people. Adolescents, who are still constructing their identities, and young adults, who are creating their intimate relationships, are most at risk for the harmful psychosocial consequences of cyberbullying (Lesnik, 2021). While the physical consequences of cyberbullying may be less severe than those of traditional bullying, the long-term damage of social-cognitive functioning (Werner & Woessmann, 2021) may impact developmental stages, particularly intimacy and relationship formation.

This research was a felt-need since a girl in one of Albanian's cities harmed herself because the digital bullying she was experiencing about her low financial situation. The episode doesn't end here, because the friends (perpetrators or bystanders) were still joking with each other and blaming her. They didn't show any form of bystander intervention or at least respect for a schoolmate whose life ended days earlier. And these phenomena happen every day. Even though they are not reflected in the media, they are rising the statistics daily.

Further research must be developed for the main reason of being informed and updated, so the preventing strategies can be implemented in schools and institutions.

1.1. Research Questions

- What are the differences in the subdimensions of cyberbullying (public humiliation, malice, unwanted contact and deception) between perpetration and victimization in the Western Balkans?
- What is the relationship between the severity of cyberbullying and the frequency of aggressive bystander intervention?
- How are the levels of cyberbullying victimization associated with the likelihood of aggressive bystander intervention?

1.2. Research Hypothesis

- Male participants will report higher levels of the "unwanted contact" and "deception" subdimensions, in contrast, female participants will report higher levels of the "public humiliation" and "malice" subdimensions of cyberbullying (both perpetration and victimization).
- There is a negative correlation between aggressive bystander intervention and the severity of cyberbullying perpetration.
- Greater levels of cyberbullying victimization are positively correlated with a higher likelihood of aggressive bystander intervention.

1.2. Literature Review

According to recent research, modern technology has transformed bullying from physical to digital methods and this change is accompanied by a sense of insecurity, which can trigger chronic stress responses (Kemeny, 2003) and disrupting brain balance (Reyneke, 2019). According to Gardella et al. (2017), being cyberbullied can cause people to internalize the experience, closing them in a "victim schema" that promotes a negative self-image and social detachment.

Kolodner and Dombo (2024) found that cyberbullying triggers many of emotional responses such as fear, anxiety, tension, panic, academic decline and tendencies towards self-harming behaviors. Lund and Ross (2017) identify that certain groups perceived as "socially diverse" are more likely to be victims. In support, Kahle (2017) points out that students who have disabilities or are part of sexual, racial or ethnic minority communities face a higher risk of experiencing online bullying than other students. According to the Merriam-Webster Online Dictionary (2002, cited in Stueve et al., 2006), a bystander is an individual who is present but does not participate in an event or situation. Mechanisms such as awareness, the blocking phenomenon (Korte, 2021), sensitivity to social cues (Parke, 1976), and diffusion of responsibility (Militello, 2019) are the main mechanisms that explain bystander behaviors (Hudson & Bruckman, 2004).

In their systematic literature review, Kezia et al., (2023) categorize cyberbullying into five types, including name-calling, teasing, denigration, impersonation and public exposure combined with deception. Furthermore, there are psychology theories that help explain what stands behind the phenomenon of cyberbullying.

From a psychoanalytic perspective, it is believed that unconscious conflicts stand behind aggressive behavior (McDonagh, 1969; Beldoch, 1975). Freud's concepts of Eros and Thanatos (Freud, 1920/1955) translate internal conflict into cyberbullying (McNally, 2003). Agreeing with this, Adler (1956) suggests that aggression responds to a need for dominance, while the work of Karen Horney (1950, cited in DeRosis, 1971) suggests that childhood insecurities can trigger coping mechanisms such as bullying.

From a behavioral perspective, cyberbullying is considered a learned response shaped by the environment and reinforcement (Powers, 1974). The concept of vicarious reinforcement explains that observing rewards for aggression (Altman & Linton, 1971) and receiving positive reinforcement through social evaluation (Skinner, 1938; Reed et al., 2010; Rachlin, 2018) support such behaviors. If aggressive behavior is accompanied by peer approval or goes unchallenged by authority figures such as family members or institutions, it further reinforces a patterned behavioral cycle (Bandura, 2006; Collins, 2022).

Piaget's work (1936, 1984) emphasizes that individuals form mental schemas through assimilation and accommodation that influence how they perceive and respond to social interactions (Tudge & Winterhoff, 1993). When these cognitive schemas are not adequately developed, individuals may react aggressively (Acredolo, 1997).

However, research on cyberbullying in the Western Balkans remains limited. This gap in the literature highlights the need for further research on victimization, perpetration and bystander behavior in the region.

Addressing these gaps is important for developing prevention strategies to reduce cyberbullying among youth in the region.

2. Methodology

This study employs a quantitative design to gather data from individuals aged 18-22 years old across six Western Balkan countries: Albania, Kosovo, North Macedonia, Montenegro, Serbia and Bosnia and Herzegovina. This age group was selected to represent youth who are digitally active and particularly vulnerable to cyberbullying dynamics. The data will be analyzed using IBM SPSS (27^{th} version).

2.1. Sampling

2.1.1. Sample Size Determination

The target sample was determined using Cochran's Sample Size Formula (Woolson et al., 1986) which for this study accounts for a 95% confidence level (Z = 1.96), with an assumed population proportion of 0.5 and a margin of error of 3% (E = 0.03). The sample size was not rounded.

The target population of individuals aged 18-22 residing in the Western Balkans, has an estimated total population of 966'200 (UN, 2025). Sample sizes were derived using proportional stratified sampling, based on extrapolated population estimates for the 15-19 and 20-24 age groups.

The formula used to ensure that the sample accurately represents the population of each country is the proportional allocation formula. Based on population estimates, calculated sample sizes were as follows: Albania (n = 191), Kosovo (n = 158), North Macedonia (n = 114), Montenegro (n = 43), Serbia (n = 379), Bosnia and Herzegovina (n = 182), summing in a total sample size of 1'066 participants.

Any surplus responses past the target sample size were removed using a stratified random deletion process. The access to the participants was ensured by a purposive strategy (contacting universities and youth organizations through email), otherwise they would be hard to access.

2.2. Instruments

The online survey consisted of three sections:

Demographic Information Form.

This section collected basic participant information, including: age, country of residence, gender and level of education.

Cyberbullying Experience Survey.

Developed by Doane et al. (2013), this instrument contains 41 items:

21 items measuring victimization experiences such as public humiliation, malice, unwanted contact and deception; 20 items assessing the same behaviors from the perspective of the perpetrator.

Responses are recorded on a 5-point Likert scale: 1) never; 2) less than a few times a year; 3) a few times a year; 4) once or twice a month; 5) every day or almost every day.

Style of Bystander Intervention Scale.

Developed by Nieblas et al. (2023), this scale consists of 15 items: intervention by 9 items and aggressive intervention by 6 items. Responses are recorded on a 5-point Likert scale: 1) never; 2) less than a few times a year; 3) a few times a year; 4) once or twice a month; 5) every day or almost every day.

2.3. Ethical Considerations

Upon clicking the survey link, participants were presented with an informed consent that detailed the study's purpose, researcher contact information, participation requirements and the voluntary right to withdraw without penalty. All data were collected anonymously, securely stored and used exclusively for academic research.

2.4. Limitations

Due to the absence of centralized registers, the pragmatic strategy that was used for reaching a relevant demographic may introduce selection bias.

3. Empirical Analyzing & Discussion

3.1. Participant Demographics

This study comprised a total of 1066 participants, with no missing data across the variables of age, gender or country of residence. Participants ranged from 18-22 years old, with the distribution displayed in Table 1.

The sample was nearly evenly split by gender: 539 female participants (50.6%) and 527 male participants (49.4%).

Table 1: Age Distribution

Age:	N	%
18 years old	202	18.9%
19 years old	162	15.2%
20 years old	321	30.1%
21 years old	189	17.7%
22 years old	192	18.0%

To assess the internal consistency of the measurement instruments used in the study, Cronbach's alpha coefficients were calculated and demonstrated excellent reliability (as shown respectively in Table 2, 3 and 4) for all three scales: the victimization scale (α = 0.981), the perpetration scale (α = 0.984) and the bystander intervention scale (α = 0.950). According to established psychometric guidelines, alpha values above 0.7 indicate outstanding internal consistency (Bland & Altman, 1997).

Reliability Statistics	
Cronbach's Alpha	N of Items
.981	21

Table 2

Reliability Statistics	
Cronbach's Alpha	N of Items
.984	20

Table 3

Reliability Statistics	
Cronbach's Alpha	N of Items
.950	15

Table 4

The descriptive means offer a portrait of cyberbullying dynamics among the participants. In the victimization scale with an overall median of 2.4, public humiliation emerged as notably higher (M = 2.85) compared to malice (M = 2.27), unwanted contact (M - 2.51), and deception (M = 1.97). In parallel, the perpetration scale (median = 2.15) exhibited a marginally elevated mean for malice (M = 2.41) relative to unwanted contact (M = 2.1), deception (M = 2.1), and public humiliation (M = 2.01), indicating a slight propensity towards harm driven by hostile intent. Furthermore, the bystander intervention scale reveals a more encouraging orientation towards constructive intervention (M = 2.76) than aggressive approaches (M = 2.05), reflecting a tendency among bystanders to favor supportive responses over confrontational ones.

Multivariate Gender Differences. A multivariate analysis of variance (MANOVA) was conducted to examine the effect of gender on various subdimensions of cyberbullying victimization and perpetration. The multivariate test using Pillai's Trace indicated no statistically significant effect of gender on the combined dependent variables, Pillai's Trace = .007, F (8, 1057) = .916, p = .502. Results were consistent across other multivariate criteria, including Wilks' Lambda. All p-values were greater than .05, suggesting that gender did not significantly influence the overall pattern of responses across the victimization and perpetration dimensions. Further univariate ANOVAs were performed on each dependent variable to investigate the potential effects of gender on individual subscales of victimization and perpetration. The results are summarized on Table 5. As digital socialization becomes more widespread and less bound by traditional gender norms, the role modeling of behaviors- both aggressive and prosocial may converge across genders. This theoretical perspective helps explain why our findings diverge from earlier studies that posited distinct gender-based patterns in cyberbullying.

Table 5: Univariate ANOVAs for Gender Differences in Cyberbullying Victimization and Perpetration Subscales

Subscale	F(1, 1064)	p-value
Victimization		
Public Humiliation	0.116	.733
Malice	0.644	.422
Unwanted Contact	0.226	.634
Deception	0.013	.908
Perpetration		
Public Humiliation	0.259	.611
Malice	0.332	.564
Unwanted Contact	0.260	.610
Deception	1.161	.281

***Note**: All tests were non-significant at $p < .05$.*

Univariate Gender Differences. Across all subscales, none of the F-tests yielded statistically significant differences between males and females ($p > .05$), indicating that gender was not a significant predictor of cyberbullying victimization or perpetration in any specific subdimension.

Moreover, the effect sizes were negligible, with all partial η^2 values < .001, indicating that gender explained virtually none of the variance in cyberbullying behaviors. In particular, male participants tended to report higher levels of unwanted contact and deception, while females showed comparatively higher levels of public humiliation and malice in both perpetration and victimization. Although some descriptive tendencies aligned with traditional aggression norms (e.g., males reporting higher unwanted contact and deception, females reporting more public humiliation and malice), these differences were not statistically significant. This suggests that digital contexts may blur rather than reinforce gender distinctions.

Table 6: Correlation Between Aggressive Bystander Intervention and Perpetration.

Correlations

		Bystander Intervention Scale - Aggressive Intervention Average	Perpetration_ Avg
Bystander Intervention Scale - Aggressive Intervention Average	Pearson Correlation	1	.834**
	Sig. (2-tailed)		<.001
	N	1066	1066
Perpetration_Avg	Pearson Correlation	.834**	1
	Sig. (2-tailed)	<.001	
	N	1066	1066

**. Correlation is significant at the 0.01 level (2-tailed).

While gender did not significantly explain variance in cyberbullying behaviors, other psychosocial factors emerged as important predictors. To further explore the relationship between aggressive bystander intervention and the severity of cyberbullying perpetration, a Pearson correlation analysis was conducted (Table 6). Hypothesis 3 proposed a positive correlation, suggesting that higher levels of aggressive intervention would correspond with greater perpetration severity. The results confirmed this prediction, revealing a strong positive correlation between aggressive bystander intervention and cyberbullying perpetration severity, $r(1066) = .834$; $p < .001$. The findings support the third hypothesis.

This significant correlation may be interpreted through both Social Leaming Theory and psychoanalytic theory. Social Learning Theory posits that aggressive behaviors are reinforced through observational learning. when individuals witness aggression. they are more likely to adopt similar behaviors themselves, while from a psychoanalytic perspective, unresolved emotional distress, particularly following victimization, may be extremized through aggressive intervention, functioning as a defense mechanism. These findings underscore the need for intervention strategies that not only support victims but also address the aggressive tendencies that can emerge within bystander dynamics.

Correlations

		Victimization_ Avg	Bystander Intervention Scale - Aggressive Intervention Average
Victimization_Avg	Pearson Correlation	1	.732**
	Sig. (2-tailed)		<.001
	N	1066	1066
Bystander Intervention Scale - Aggressive Intervention Average	Pearson Correlation	.732**	1
	Sig. (2-tailed)	<.001	
	N	1066	1066

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7: Victimization and Aggressive Bystander Behavior Pearson Correlation

Victimization and Aggressive Bystander Behavior. Hypothesis 4 proposed that greater levels of cyberbullying victimization would be positively correlated with an increased likelihood of aggressive bystander intervention. To assess this, a simple linear regression was conducted, with victimization severity as the predictor and aggressive bystander intervention as the dependent variable.

As shown in Table 7, a strong positive correlation was found between cyberbullying victimization and aggressive bystander intervention. A linear regression (Table 8) further confirmed that victimization significantly predicted aggressive intervention behaviors, accounting for approximately 53.6% of the variance in the outcome.

The results indicated a strong, statistically significant positive relationship, $R = .732$, $R^2 = .536$, $p < .001$, suggesting that approximately. 53.6% of the variance in aggressive intervention behaviors can be explained by levels of victimization. The unstandardized regression coefficient was significant, $B = .258$, $t(1064) = 35.08$, $p < .001$. indicating that for each one-unit increase in victimization severity, the aggressive intervention score increased by 0.258 units on average.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.732[a]	.536	.536	4.87153

a. Predictors: (Constant), Victimization_Avg

Table 8: Victimization and Aggressive Bystander Behavior Regression Analysis

These results demonstrate a clear and strong association between the experience of victimization and the likelihood of engaging in aggressive forms of bystander intervention. The strength of this correlation and the proportion of variance explained suggest that victimization does not only evoke emotional responses, it also influences behavioral tendencies toward aggression when intervened. Supporting our fourth hypothesis, greater experiences of cyberbullying victimization were significantly associated with a higher likelihood of engaging in aggressive bystander intervention.

Conclusions and recommendations

This study examined cyberbullying among young people aged 18-22 years in six Western Balkan countries, using data from 1,066 participants. Contrary to traditional gender assumptions, multivariate analyses did not reveal any significant overall effects of gender on victimization or perpetration. However, it was found that males reported more unwanted touching and teasing. while females experienced higher incidents of public humiliation and malice. A strong positive correlation between aggressive bystander intervention and severity of perpetration ($r = .834$, $p < .001$) highlights a consistent association between aggressive intervention while witnessing bullying. Furthermore, regression analyses showed that the level of victimization accounted for 53.6% of the variance in bystander aggressive responses ($R2 = .536$, $p < .001$), suggesting that victims may adopt similar tactics to perpetrators as coping strategies for bullying. To break these cycles, interventions should be promoted through peer mediation and controlled by institutional or algorithmic rules from online platform managers themselves. Educating witnesses through scenario-based training, clear reporting protocols, and development of prevention skills can foster proactive support rather than aggression. Integrating Social and Emotional Learning into core school curricula will further strengthen communication skills and the well-being of the student community. Finally, creating a way to measure cyberbullying across regions, collect incident data and monitor trends will enable evidence-based policymaking. Through these strategies, policymakers can ensure safer digital environments, strategies that work not only in the Western Balkans but across all regions.

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UNIVERSITY OF SHKODRA "LUIGJ GURAKUQI"
FACULTY OF ECONOMICS

Department of Business – Administration

Scientific Research Competition
JSTOR

Field of study: Organizational Psychology and Human Resource Management

"The Impact of Expectancy, Instrumentality, and Valence on Job Satisfaction"

Sinoida Shkambi

Bachelor, III- rd Year

Shkodër, 2025

Abstract

In an increasingly competitive work environment, where employee performance and motivation are critical factors for organizational success, understanding the elements that influence job satisfaction is essential. This study aims to analyze the impact of expectancy, instrumentality, and valence, based on Vroom's Expectancy Theory (1964), on job satisfaction among employees in both the public and private sectors. Using a structured questionnaire administered to a sample of 91 individuals, statistical analysis was conducted using SPSS 27, including regression analysis, descriptive statistics, and factor analysis. The results showed that all three factors have a statistically significant impact on job satisfaction. The study supports the need to strengthen the clarity of expectations and the connection between performance and rewards in the workplace. The findings provide valuable insights for human resource management and encourage strategic interventions to enhance both job satisfaction and performance.

Keywords: *expectancy, instrumentality, valence, job satisfaction, expectancy theory, motivation. (Locke, 1976)*

1. Introduction

In recent decades, job satisfaction has become one of the most extensively studied topics in the field of organizational psychology and human resource management. Modern organizations, facing intense competitive challenges, have recognized that employee satisfactionis is strongly associated with productivity, innovation, and organizational sustainability (Judge, Weiss, Kammeyer-Mueller, & Hulin, 2017). Among the factors that influence job satisfaction, Victor Vroom's Expectancy Theory (1964) stands out as one of the most powerful explanatory models of work motivation (Muchinsky, 1977; Locke, 1976).

According to the expectancy theory, employee motivation results from three key components: expectancy (the belief that effort will lead to good performance), instrumentality (the belief that performance will be rewarded), and valence (the personal value the individual assigns to the reward). A lack of balance among these components can negatively affect motivation and job satisfaction (Van Eerde & Thierry, 1996; Muchinsky, 1977).

In this context, the present study aims to analyze the impact of expectancy, instrumentality, and valence on the job satisfaction of Albanian employees, taking into account both the public and private sectors. The study contributes to the existing literature by providing empirical data in a context where research on this topic is still limited (Muchinsky, 1977).

1.1 Research Question

Do expectancy, instrumentality, and valence influence employee job satisfaction (Pritchard & Sanders, 1973)?

The purpose of this question is to highlight the importance of understanding these factors in relation to job satisfaction and to inform managerial practices and labor policies.

1.2 Study Objectives

1. To examine the impact of expectancy on job satisfaction: To analyze how "employees' perception" of their ability to achieve a desired outcome influences their job satisfaction. (Muchinsky, 1977)

2. To assess the impact of instrumentality on job satisfaction: To investigate how "employees' belief" that their efforts will lead to concrete rewards affects their level of job satisfaction. (Muchinsky, 1977)

3. To analyze the impact of valence on job satisfaction: To evaluate how the importance employees assign to potential rewards or outcomes influences their perception of job satisfaction. (Muchinsky, 1977)

4. To compare the impact of expectancy, instrumentality, and valence on job satisfaction: To determine which factor (expectancy, instrumentality, or valence) employees consider most important in achieving a high level of job satisfaction. (Muchinsky, 1977)

5. To provide recommendations for managerial practices that can enhance job satisfaction: Based on the study's findings, to offer suggestions for managers and organizations that can be used to increase employee motivation and satisfaction through the effective management of expectations and rewards. (Muchinsky, 1977)

2. Literature Review

2.1 Vroom's Expectancy Theory (1964)

The Expectancy Theory, proposed by Victor Vroom in 1964, is one of the most well-known motivation theories in management. Vroom suggests that individuals are motivated to act if they believe their effort will lead to desired outcomes. He identifies three key variables that influence motivation: expectancy, instrumentality, and valence. According to this theory, an individual will invest significant effort if they believe they will be rewarded for their achievements and that the reward holds substantial value for them. (Vroom, 1964; Behling & Starke, 1973)

2.2 Expectancy

Expectancy refers to the belief that effort will lead to successful performance. When individuals expect to achieve good results through their efforts, they are more motivated to act. This concept is closely related to individuals' confidence in their abilities and the support they receive from management to reach set goals. (Mitchell & Albright, 1972)

2.3 Instrumentality

Instrumentality is the belief that good performance will lead to desired rewards. This factor is related to the value individuals place on the rewards and recognition they may receive after achieving a certain level of performance. The degree of belief in the instrumentality of an action can significantly influence employee motivation and engagement. (Lawler, 1968; Graen, 1969; Pritchard & Sanders, 1973; Turney, 1974)

2.4 Valence

Valence concerns the value individuals assign to rewards. The reward can be financial, such as salary, or non-financial, such as recognition of achievements and promotion opportunities. When individuals consider the reward important and valuable, they are more motivated to work successfully and meet set objectives. (Pritchard & Sanders, 1973)

2.5 Job Satisfaction

Job satisfaction is a general feeling of contentment individuals experience toward their work. It is closely linked to factors such as the nature of the work, colleagues, management, and the benefits individuals receive. Work that holds high value for individuals and provides development opportunities is often a source of high job satisfaction. Expectancy, instrumentality, and valence are factors that can directly influence job satisfaction, as they contribute to employee motivation and engagement. (Muchinsky, 1977; Locke, 1976)

2.6 Previous Studies

Previous studies on the impact of expectancy, instrumentality, and valence on job satisfaction have produced varied results. Some studies have shown that expectancy and instrumentality are the most important factors in employee motivation and directly affect their job satisfaction. On the other hand, other studies have emphasized the importance of valence, demonstrating that rewards and recognition are also critical to job satisfaction. These studies suggest that motivation is a complex process involving different interactions between various factors, including expectancy, instrumentality, and valence. (Muchinsky, 1977)

3. Methodology

Population

The study includes employees from both the public and private sectors, ensuring a diverse sample to analyze the factors that influence job satisfaction. (Muchinsky, 1977)

Sample

The sample consists of 91 individuals who were randomly selected from the target population. This sample size is adequate for drawing reliable conclusions and for reflecting the reality of employees in both sectors. The questionnaire was administered face-to-face, allowing for any questions or difficulties that may arise during completion to be clarified immediately, ensuring the responses are as accurate and useful as possible for the study.

Instrument

The structured questionnaire used in the study includes questions that cover the key variables: expectancy, instrumentality, valence, and job satisfaction. This instrument was suitable for collecting accurate data and measuring participants' perceptions regarding these variables. (Muchinsky, 1977)

Variables

Expectancy: Measures employees' perception of the likelihood of achieving desired outcomes through their efforts (question 5 in the questionnaire). (Mitchell & Albright, 1972)

Instrumentality: Reflects employees' belief that achieving desired outcomes will lead to concrete rewards (question 6). (Pritchard & Sanders, 1973; Graen, 1969)

Valence: Assesses the importance employees place on potential rewards or outcomes (question 7). (Pritchard & Sanders, 1973)

Job Satisfaction: The dependent variable that measures the level of satisfaction employees feel in their jobs, which depends on perceptions of expectancy, instrumentality, and valence. (Pritchard & Sanders, 1973; Graen, 1969; Locke, 1976)

3.1 Research Hypotheses

Hypothesis 1: There is a statistically significant relationship between the expectancy factor and job satisfaction.

Hypothesis 2: There is a statistically significant relationship between the instrumentality factor and job satisfaction.

Hypothesis 3: There is a statistically significant relationship between the valence factor and job satisfaction.

4. Results Analysis

4.2 Data Analysis Method

To analyze the data, the statistical software SPSS Statistics 27 was used. The data collected through the questionnaire were manually entered into the program. Data analysis was conducted using Factor Analysis, which makes it possible to identify whether the factors included in the study are statistically significant. Additionally, regression analysis was conducted to examine the relationship between the independent variables included in the study — "expectancy," "instrumentality," and "valence" — and the dependent variable, "job satisfaction," which also aligns with the study's hypotheses.

4.3 Descriptive Statistics

Descriptive statistics include numerical and graphical procedures that summarize and present the data in a simpler and more understandable way (Thompson, 2009).

Table 1. Socio-demographic characteristics of the respondents

Variable	**N**	**Frequency**	**Percent**
Gender	91		
Female	91	47	51.6
Male	91	44	48.4
Age	91		

18-25	91	15	16.5
26-33	91	25	27.5
34-41	91	18	19.8
42-49	91	14	15.4
50-57	91	11	12.1
Over 57	91	8	8.8
Education	91		
Low	91	16	17.6
Medium	91	34	37.4
High	91	41	45.1
Employment	91		
Private	91	45	49.5
Public	91	25	27.5
Both sectors	91	21	23.1

4.4 Factor and Reliability Analysis

Factor analysis is a statistical method and process in which the observed data values are expressed as functions of a number of possible factors, to identify which ones are the most important (Costello & Osborne, 2005). It involves grouping certain variables and determining how many items should be included under a single factor. Reliability analysis is performed using Cronbach's Alpha comparison. Each item must have a Cronbach's Alpha value higher than 0.7 in order to be considered statistically significant (Santos, 1999).

To conduct the factor analysis for expectancy, instrumentality, and valence, three statements—also referred to as sub-factors—were presented for each construct. These statements were measured using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Through factor analysis, each sub-factor is expressed in terms of its factor loadings.

Table 2. Factor analysis

Factor/Statement	**Cronbach Alpha/ Factor Weight**
Expectancy:	
5-1 I am confident that I have the necessary skills and abilities to perform this job	0.793
5-2 I believe that the external environment facilitates performance	0.876
5-3 I am confident that my efforts at work make a difference	0.816
Instrumentality:	
5-4 I am confident that I will be rewarded after successfully completing my work	0.888
5-5 I am informed in advance about the rewards I will receive	0.898
5-6 I eliminate poor performance after receiving the reward	0.998
Valence:	
5-7 The reward is very important to me	0.777
5-8 The rewards I receive compared to others are fair	0.863
5-9 I have the ability to choose among the offered rewards	0.923

4.5 Multiple Regression

After verifying the statistically significant statements that define the elements of motivation according to Vroom—specifically our independent variables—we proceed with the regression analysis.

Table 3: Multiple Regression Model

Model	Correlation Coefficient (R)	Coefficient of Determination (R^2)
1	0.847	0.715

In the table above, information is provided for the correlation and regression coefficients. The correlation coefficient, R = 0.847, is positive, meaning there is a strong positive relationship between our independent variables and the dependent variable. The coefficient of determination, R^2 = 0.715, indicates that 71.5% of the variance in the dependent variable, job satsfaction, is explained by the contribution of the independent variables included in the study: expectancy, instrumentality, and valence.

Table 4: ANOVA Table of the Multiple Regression

Modeli	Sum of squares	df	Mean Square	F	Sig.
Regression	257.258	3	85.753	20.599	0.000
Residual	578.684	139	4.163		
Total	835.942	142			

Dependent Variable: Job Satisfaction

Independent Variables: Expectancy, Instrumentality, and Valence

From the data in the table above, we can clearly observe that the value of P(sig) = 0.000 is smaller than the Cronbach Alpha coefficient ($\alpha = 0.05$). This indicates that our multiple regression model is statistically significant. Therefore, at least one of the independent variables included in the study explains, in a statistically meaningful way, our dependent variable, which is employee performance.

Table 5: Multiple Regression

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**T**	**Sig.**
	B	**Std.error**	**Beta**		
(Constant)	0.457	0.218		3.173	0.000
Expectancy	0.389	0.419	0.379	3.245	0.001
Instrumentality	0.457	0.072	0.450	2.779	0.025
Valence	0.576	0.178	0.583	3.989	0.003

Dependent Variable: Job Satisfaction

Independent Variables: Expectancy, Instrumentality, and Valence

To determine which variables significantly influence job satisfaction, we examine the significance levels (Sig) of each motivation factor. These values should be lower than the Alpha level of 0.05.

Specifically:

Constant: Sig = 0.000 < Alpha = 0.05; statistically significant

Expectancy: Sig = 0.001 < Alpha = 0.05; statistically significant

Instrumentality: Sig = 0.025 < Alpha = 0.05; statistically significant

Valence: Sig = 0.003 < Alpha = 0.05; statistically significant

Using the data from the table above, we can now respond to the hypotheses formulated at the beginning of the study and build the final regression model:

Job Satisfaction = 0.457 + 0.389 (Expectancy) + 0.477 (Instrumentality) + 0.576 (Valence)

Since all the Beta coefficients are positive, the relationship between each independent variable and the dependent variable (job satisfaction) is positive.

Conclusions and Recommendations

The main objective of this study was to analyze employee motivation and job satisfaction. Through factor analysis, the statistically significant factors included in Vroom's motivation model were identified. It was found that all three factors—expectancy, instrumentality, and valence—along with the statements measuring these factors, are statistically significant. Through regression analysis, the contribution of each of the motivation factors to job satisfaction was identified. It was found that job satisfaction is explained 71.5% by the three elements involved in motivation. The relationship between each of the elements and employee performance was found to be positive. As the employees' expectations increase, their job satisfaction increases by approximately 0.39 points. As the instrumentality factors that influence employees' motivation increase, their job satisfaction increases by approximately 0.48 points. As the valence factors affecting employees' motivation increase, their job satisfaction increases by approximately 0.58 points.

Since motivation is one of the key elements that affect employees in performing tasks effectively, and consequently their job satisfaction, managers or leaders of organizations should pay special attention to it. They can design motivating programs, which may include both monetary and non-monetary incentives. For monetary incentives, bonuses for successful work can be included. For non-monetary incentives, extended annual leave, certificates for work performance, organizing a weekend break, providing a suitable working environment, and similar options can be included. In this way, managers will be able to increase the commitment, job satisfaction, and performance of their employees. Both existing and new employees will be more motivated to perform their work and more satisfied with their performance. (Lawler, 1968) (Graen, 1969) (Turney, 1974)

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UNIVERSITY OF MEDICINE, TIRANA

FACULTY OF TECHNICAL MEDICAL SCIENCES

Department of Preclinical Subjects

Scientific Research Competition

JSTOR

Field of study: Radiology,Artificial Intelligence and Paediatrics

"Integrating Artificial Intelligence in Pediatric Fracture Detection through X-rays: A Medical Imaging Approach"

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Bachelor, III- rd Year

Tiranë, 2025

Abstract

The world of pediatric fracture detection has been revolutionized by AI with the application of deep learning in furthering medical imaging. An insight provided through extensive research on the application of AI, particularly with tools such as Convolutional Neural Network, in accurately and swiftly detecting fractures in pediatric patients using X-ray imaging. The structure of pediatric bones is complex, with fractures presenting vague or minimally discernible signs. Therefore, AI will assist radiologists in identifying fractures that would otherwise be invisible to the human eye. This article will explore existing literature and current practice before demonstrating AI-enabled enhancement of the diagnostic process to improve accuracy, reduce diagnostic errors, and enable better clinical decision-making.

GRAZPEDWRI-DX has proven that artificial intelligence has powerful diagnostic skills and is recommended for most of the fracture cases of children. Overall, AI software needs to have a high level of reliability and efficiency so that it can be used properly. This paper presents AI as a helper to support doctors in patient care now and in the future. The AI devices of the future can not only offer diverse innovative applications and reduce the expense of patient diagnostic testing, in addition allow the medical staff to be more efficient financially in the case of pediatric bone fractures when they use AI.

Keywords*: artificial intelligence, pediatric fractures, medical imaging, deep learning, convolutional neural network (CNN), X-ray, AI-assisted diagnosis, GRAZPEDWRI-DX, clinical decision-making, diagnostic efficiency.*

1.Introduction

Radiologists may face difficulties detecting fractures in children as their bone structures vary from those of adults, and the fractures may stay undetected. Some fractures, being tiny and the bony structure of children being a bit complicated, may go undetected. The emergencies often make them take fast decisions, which may be wrong. This is where AI can make a difference. By utilizing deep learning, AI can analyze medical images and detect patterns that a doctor may not discover. AI can be a useful tool for supporting physicians by allowing them to be more accurate in their work, commit fewer mistakes, and accelerate the diagnosis process.

This paper represents the effect of AI on the identification of different types of fractures in children. It discusses the application of deep learning techniques in diagnosing fractures from X-rays of children. It explores the benefits of incorporating AI in daily practice, while relying on scientific journals and patient cases, including situations experienced in Graz Hospital.

The research outlines the AI implementation that enhances pediatric fracture diagnosis precision, along with its investigation of AI decision system ethical hurdles and transparency needs. The main function of AI operates as a professional enhancement tool for medical personnel instead of attempting to replace them in their roles.

2.Literature review

Artificial Intelligence (AI) has revolutionized healthcare in general and radiology especially as a future-leading force, one that is going to accelerate medical diagnosis, rendering it more precise, while also taking diagnostic procedures to a higher level. One of the primary tasks of AI is to enhance diagnosis interventions and its capability to identify children's fractures on X-rays. In this article, literature on the application of AI techniques, i.e., deep learning, for the detection of pediatric fractures will be gathered, and an opinion regarding its pros and cons will be expressed.

Deep learning, a branch of artificial intelligence, was also found to be useful to apply to medical images due to the capabilities of deep learning to acquire hierarchical representation abstractions of data.

Deep learning algorithms, Nagendran et al. (2020) asserted, "learn themselves the features of an image which are relevant to classification and not told so by humans" (Nagendran et al., 2020). Self-training is facilitated, and AI may build patterns not necessarily apparent to doctors, increasing the accuracy of image classifications. For instance, models like deep neural networks

(CNNs) may classify fracture types from X-rays of children, which are feeble and difficult to identify to human eyes, especially complicated pediatric fractures. With the evolution of deep learning techniques, the possibility of AI surpassing human beings in any field has become a reality.

Goldhahn et al. (2018) documented that AI in radiology can make more accurate diagnoses than doctors (Goldhahn et al., 2018). This applies to fractures in children, where pediatric anatomy complexity is a limiting factor to routine radiological interpretation. AI's ability to process vast datasets and detect fractures with greater precision holds the promise of reducing diagnostic errors, which can be particularly detrimental in pediatric care.

The specific application of AI in pediatric fracture detection has been the subject of several studies.Shelmerdine et al. (2022) conducted a systematic review of AI applications in pediatric radiology, focusing on acute appendicular fractures in children. What their research truly found, however, is that the widest field of AI research done in this field is on upper limb fractures, and most particularly at the elbow, where fractures occur most commonly (Shelmerdine et al., 2022). The ability of AI to diagnose such fractures more accurately, even in fractures without visible deformity, has the potential to change pediatric fracture diagnosis and provide faster, more accurate treatment options. Additionally, Kutbi (2024) continued to describe that conventional imaging modalities like X-rays and CT scans are time-dependent (Kutbi, 2024).

AI in such applications can minimize human experience dependency with simpler and quicker fracture detection. The ability of deep learning models to be trained on vast sets of labeled X-ray images holds the promise to detect fracture patterns with high sensitivity and specificity and a low false-negative rate of missed diagnosis.

Although AI is replete with great promise in pediatric fracture diagnostic accuracy precision enhancement, there are many challenges on the horizon.

One of the most basic problems, as noted by Bonifazi et al. (2020), is that AI algorithms are "black boxes" in the sense that the decision is not feasible to be explained at any given point in time (Bonifazi et al., 2020). That explainability will erode the trust of physicians to use AI, especially in an environment such as fracture detection for pediatric wards, where the misdiagnosis will be disastrous. As noted by Larasati and DeLiddo (2020), being unable to offer explainable explanations as to why AI does this or that prevents clinicians from knowing and checking AI-

driven diagnoses (Larasati & DeLiddo, 2020). In addition, ethical matters involving medicine and AI, specifically the capability for decision-making once the sole prerogative of human clinicians, must be put aside. Horgan et al. (2019) went on to say that while as much as possible the AI might be tuned to augment the clinical performance from data information, even at its optimum scenario, its application would also align with human sense in high-context and complex-in-nature clinical cases such as a child's fractures (Horgan et al., 2019).

Clinical integration of AI, i.e., pediatrics fracture diagnosis, is still ongoing. Oppenheimer et al. (2023) mapped future application of AI fracture detection software in clinic routine and opined that while AI software like Gleamer BoneView was extremely sensitive in fracture detection (up to area under the curve of 0.97), in practical life the problem is not how to employ AI tools but how to employ AI tools in day-to-day routine clinical life without any hindrance (Oppenheimer et al., 2023).

Application of AI systems in pediatric radiology for optimal exploitation will encompass workflow planning with accuracy to involve clinician training and regular testing of the AI algorithm. The future for AI applications to detect pediatric fractures could be to assist, and not replace, the clinician. AI is also investigated for other applications of diagnosis in radiology, such as fracture detection, and may be an effective tool to aid clinical decision-making (World Health Organization, 2021). Collaboration of AI computational resources and human capacity may turn the children's fractures into a better result and reduce expenditures for the healthcare system.

As a conclusion, the use of AI for the diagnosis of pediatric fractures on X-rays is a most advantageous clinical imaging technology. Deep learning can be employed in a way that AI can enhance diagnostic performance, decrease the workload for clinicians, and enhance patient outcomes. However, reliability and ethical issues need to be tackled to make its use an effective innovation within the hospital setting. Since there will be constant development in AI technology, AI use in the detection of pediatric fractures will widen.

3. Methodology

Research compares various AI systems' ability to diagnose fractures in children. In this research, the data consisted of a study activity in which patients who had been hospitalized in the University Hospital Medical Centre, Graz, were analyzed.

Research began with JSTOR serving as the database of research, which attained validity upon

high-quality and credible sources for publications regarding the usage of AI in radiology. All the discourse on the definition of artificial intelligence was discussed in review articles for material such as Convolutional Neural Networks (CNNs) used on X-rays for kids. It was also condensed into the project case study, combining findings from the literature to bring another layer of comprehension to the entire field.

During the internship, I opted to be exposed to hospital personnel, performing pediatric imaging high-quality procedures at the University Hospital, Graz. Having been exposed to research data as it is in real life observed, medical diagnosis was unveiled to me.

Prof.Sebastian, my supervisor during the internship and one of the authors of GRAZEDWRI-DX, gave me access there.

The GRAZEDWRI-DX database was utilized because of its ability to easily capture a high volume of X-ray data of children with trauma. It was from this particular database that AI had its evidence concerning the accuracy of results in the context of detection capability when it comes to small fractures.

This was pertinent to me since the foundational architecture has been re-visited much deeper and utilized for much higher-order steps in the training and testing metrics. In determining how well this AI model can enable radiologists to identify fractures, we have explored the accuracy with which this AI model has performed in comparison to sensitivity and specificity.

The public's AI diagnosis of the child's illness was seen in the light of trustworthiness and transparency, and the trust model formation. All AI medical technologies create a series of tools that are used to aid the clinician in maintaining intensive clinical care that has always been a prerogative of a human act.

For all of these radiographic findings in AI, four pediatric patients were independently reviewed and analyzed by me on my clinical rotation in Tirana, including cases without radiographic evidence of fractures and with a complete green stick fracture, compared with the AI submission for comparison of the interpreted analysis.

4. Clinical cases

Case 1: AI Detection of Subtle Greenstick Fracture in a Pediatric Wrist

Image ID:0048_0915621999_01_WRI-L1_F014

Patient: 14 years old, female

Projection viewed: posteroanterior (PA) left wrist

Label: positive for greenstick fracture

Referenced to Fig. 1

The image shows a very slight greenstick fracture along the left ulna bone of a child in the PA wrist X-Ray. The deep learning system with CNNs precisely identified this unnoticeable fracture, which the human eye would miss initially.

A cortical abnormality, along with its correct identification, matched the output of both the AI model and experienced pediatric radiologists. AI technology facilitates borderline fracture detection in clinical practice, through which it helps diminish reading discrepancies and allows ED triage functions. The high detectability and training capacity of AI in pediatric fractures medicine has been validated across numerous studies (Kim et al., 2021; Stuby et al., 2022).

Case 2: AI Detection of a Pediatric Wrist Fracture: A Case from GRAZPEDWRI-DX

Image ID:0003_0662359226_01_WRI-R1_M011

Patient: 11 years old, male

Projection viewed: posteroanterior (PA) right wrist

Label: positive for fracture

Referenced to Fig. 2

Research into AI technology assessment uses contemporary studies to evaluate its performance in children's fracture detection according to Stuby et al. (2022) and Kim et al. (2021). A wrist fracture was identified in this case by radiologists.

The independent operation of the CNN-based AI system detected cortical abnormalities using the same precision standards as specialist readers for a marker and heatmap-free operation. Standard clinical exams would not reveal visible yet undetectable indicators that the system successfully detected.

Using AI in medical images brings two key outcomes: benchmarking reader consistency and aiding clinicians to finish their work. Medical workflow readiness of AI assessment strategies finds

its demonstration through the heatmap system, which serves as an explainability tool.

Case 3 - The Limits of Artificial Intelligence: Missed Fracture on a Lateral Wrist X-Ray
Image ID: 0012_0542128240_01_WRI-L2_M013

Patient: 13.4 years

Projection viewed: posteroanterior (PA) left wrist

Label: positive for fracture (expert consensus opinion)

Referenced to Fig. 3

A major performance challenge acts as a fundamental limitation during today's application of artificial intelligence systems in pediatric radiography practice. A radiologist performed an extensive examination of a hidden stress fracture of the wrist in a 13-year-old patient for accurate diagnosis. The AI system failed to recognize the lesion because undefined morphological features among complex anatomical structures existed in the training dataset. Medical professionals must directly observe patient cases because AI diagnostic systems prove ineffective in analyzing difficult clinical scenarios.

Additional clinical cases from the University Medical Center of Tirana "Mother Teresa"

I collected these pediatric X-rays during my practice at QSUNT. Although AI was not used in diagnostics, they constitute a comparative part in the use of AI in similar cases.

Case 1 – Normal Pediatric Wrist (PA View)

Referenced to Fig.4

The PA X-ray of a child's hand reveals normal bone pattern developing patterns, which help medical staff to carry out successful interpretations.

Medical practitioners utilized this X-ray to follow contemporary clinical practice in their professional scholarly cycle. The machine learning service enables models to identify normal and abnormal patterns through training from itself based on its existing knowledge base.

Case 2 – Normal Lateral Wrist View

Referenced to Fig. 5

A verification of the X-ray image ensures correct positioning of the distal ulna segment when

confirming that its lateral edge has no patterns of a broken bone.

Lack of distinguishing features in medical images requires the establishment of an effective dorsal cortical displacement diagnostic method. This case application delivers optimum benefits in medico-technical AI research, as trauma clinics require immediate, rapid work execution procedures.

Case 3 – Greenstick Fracture (PA View)

Referenced to Fig.6

PA image shows a greenstick fracture due to its reference to partial fractures of distal patterns of cortical bones, together with a deformed radius.

Medical staff is supported with the incorporation of clinical workflow software and CNN application technology since it offers more accurate diagnosis of asymmetry to detect conditions early enough.

Case 4 – Greenstick Fracture (Lateral and PA View)

Referenced to Fig 7,8

In these images, all the signs of greenstick fractures are recognizable by a radiologist.

Traditional PA projection diagnosis teaches us about how AI methods work when advanced methods of observation lead to multiple diagnosis outputs.

Fig.1

Fig.2

Fig.3

Fig.4

Fig.5

Fig.6

Fig.7

Fig.8

5. Results

From both the literature review and clinical cases, I believe there are positive outcomes for fracture diagnosis through deep learning systems with CNNs. Utilizing both JSTOR and respected sources to gain evidence about AI detection systems for fractures in challenging growth plate regions of children. The AI systems demonstrate more than 90% detection accuracy when processing GRAZPEDWRI-DX reports. During my internship, I witnessed the functionalities of these instruments. Medical practitioners use AI technology to enhance specific clinical operations and actively implement AI diagnostic solutions into their professional practice. Fracture indicators and heatmaps served as research tools to help doctors accept this technological advancement. The newest medical imaging equipment demonstrates powerful advancements in diagnosing child

fractures during clinical practice. This technology needs medical practitioners to work together permanently with computer scientists and needs extensive training datasets to function properly. The present set of ethics guidelines needs to achieve a precise definition.

6. Discussions

The advent of AI in the diagnosis of fractures in children is the true paradigm shift in diagnostic radiology. Behind this paper's claims lies accumulating evidence that deep learning models, most notably CNNs, are a promise to enhance diagnostic performance in children, where fractures, delicate to egregious in developing bone structures, are often insidiously missed. The concurrence of the literature reviewed on JSTOR and other academic sources was very powerful in momentum: AI could serve as an expert second reader, thereby diminishing inter observer variation and providing more confidence to clinicians about their diagnosis. Experiments on the GRAZPEDWRI-DX dataset also supported AI models, where they were not only extremely precise but also practically deployable in regular clinical practice.

Secondly, first-hand data gained through experience with clinical practice in the Hospital of Graz may become locally suitable expertise. AI still has not come to terms with normative pediatric diagnostics; however, the organization's inclination towards recent technology and research efforts strongly articulates openness towards such work.

Computerized processes may entice the will of clinical skill. Such dependence is morally questionable. An AI is not meant to replace clinical judgment or assessment but to support clinicians.

Following the conclusions of this research, there is a clear call for interprofessional collaboration involving engineers, radiologists, and ethicists. That collaboration will drive AI tools from research endeavors into clinically trustworthy aids.

Conclusion & Recommendations

Through AI usage and Deep Learning techniques, pediatric fracture diagnosis has become continuously available at any time through more precise yet consistent and swift processes. Researchers use AI models, specifically CNN, to extract injury-sensitive data from children when human analysis would produce subpar results in this study. AI would serve as an exceptional supplemental tool in the radiology domain. AI needs to be fully explainable with strong ethical foundations while remaining under supervised use by specialist radiologists.

Recommendations

The medical profession demands that AI models become transparent because this transparency creates trust in such sensitive issues, especially when pediatric radiology guides children through the process.

Multiple hospital-based large-scale trials of AI detection solutions must be conducted to validate their real-world effectiveness and safety for injury identification.

Medical radiology students should learn about the benefits and drawbacks of AI software during their educational training to maximize their AI tools.

Multiple forums should exist for engineers to collaborate with radiologists and ethicists for developing AI algorithms that are technically viable and clinically effective.

Healthcare institutions should develop a framework and policy to issue guidelines about patient data practices while handling algorithmic biases and AI-enabled diagnostic costs.

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UNIVERSITY OF PRISHTINA

FACULTY OF ELECTRICAL AND COMPUTER ENGINEERING

Department of Computer and Software Engineering

Scientific Research Competition

JSTOR

Field of study: Software Engineering and Distributed Systems

"CPU Consumption in Microservices – Based and Monolithic Applications"

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Master of Science in Computer and Software Engineering, II- nd Year

Prishtinë, 2025

Abstract

In the development of software systems, starting from systems with monolithic architecture to systems with microservices, they have managed to bring improvements from time to time. Starting with microservices, which have developed systems in such a way that the components are independent of each other, which makes its construction and use more efficient, enabling the construction of modern applications. From these developments we have new problems especially with resource consumption, in this case with CPU usage. From various scientific papers analyzing applications with microservices, usage and construction are studied in comparison with the impact and CPU usage under different user loads in a specific microservices application. This is also missing in many literatures as an untreated part. In this paper we will focus more on the analysis through the comparison between monolithic applications with those with microservices which have the same functions but are built on different architectures. The comparison and increase of the loads for this part of the experiment is carried out with Apache JMeter while their monitoring is carried out with VisualVM 2.2, the results that are expected to be achieved are the impact of the architecture on resource consumption, time and capacity for each. From the results, we finally reach some conclusions that an application with monolithic architecture shows higher efficiency with lower loads while those with microservices have better results with higher resource consumption requirements, although a consumption with higher values is seen.

Keywords: *scalability, architecture impact, performance, microservices*

1. Introduction

Software systems have a transition over the years, replacing systems with monolithic architectures with microservices. These changes have improvements in application performance and consumption, but as such, they have also raised major questions about resource consumption, especially processor consumption (Nance & Bhat, 1978; Boffey, 1989).

The topic of discussion in two types of system architectures: monolithic and microservices. Microservices are applications that are easy to maintain, which introduce overhead due to the need for continuous communication through services (Boffey, 1989), while monolithic applications execute in a single unit. This offers high efficiency in resource consumption for better performance because they lack the overhead of separate services but have limitations in scalability (Ahituv & Elovici, 2001; Datta et al., 2003). Application performance depends on the system resources used, according to studies (Dutta et al., 1982). If we compare monolithic applications with microservices, they will increase CPU consumption due to the overhead created when communicating with separate services (Author et al., 2024; Ponce et al., 2021).

When choosing to implement a monolithic application or a microservices application, the choice of which architecture will change the performance of the application (Wei, 2017). A monolithic application has a better use of resources because there is no communication between multiple services, while if compared to a microservices application then maintenance may be easier, but there will be an increase in processor consumption (Wei, 2017; Govett et al., 2017).

1.1. Objectives of the study

The purpose of this paper is to analyze how application architecture affects the processor (CPU) of my laptop, making a comparison between two applications with (monolithic and microservices architectures).

The major contributions of the paper are:

1. The comparison of CPU (through the experiments) of two types of applications by comparing them under the same conditions;

2. The analysis of performance under different load conditions classified as (low, medium, high load);

3. Being capable of identifying scenarios where one architecture is better than the other.

1.2. Purpose of the study

The purpose of the paper is mainly to compare the CPU consumption in the two types of architectures for a given application and to determine which of them will be the most suitable.

From the analysis that will be obtained, we will try to understand how the performance and management of the processor changes between these two types of architectures. Factors that affect CPU consumption such as scalability and load will have a more specific treatment.

2. Related work

When we try to migrate applications from monolithic to microservice architectures will not always result. This will guarantee performance. Studies show that CPU consumption increases after application partitioning, especially when tested under normal load conditions (Dongarra et al., 2020; Taibi et al., 2018; Balalaie et al., 2016). Papers that highlight the challenges of application design based on the architecture (Berman & Nigam, 1992; Dragoni et al., 2017). So many papers have highlighted the importance of migration configuration to prevent performance degradation (Obermaisser & Peti, 2007; Amaral et al., 2021). However, applications that have high demands may justify these.

Table 1 presents a summary of the most important findings in this field.

Table 1. Summary of findings for this area

Study	**Type of study**	**Focus**	**Results**
Dongarra et al., 2020	Industrial experiment	Migration and resource measurement	CPU increases
Berman & Nigam, 1992	Conceptual analysis	History and theories about microservices	Modularity increases
Obermaisser & Peti, 2007	Industrial survey	The real challenges after migration	Huge overhead
Dragoni et al., 2017	Mapping study	Patterns and service separation	Performance degradation

Taibi et al., 2018	Experimental comparison	CPU & latency between architectures	Microservices don't Consume more CPU
Balalaie et al., 2016	Real comparison between applications	Test of the same system on two architectures	Monolithic application in smaller loads is better.
Amaral et al., 2021	Metrics	Performance measurement after application migration	Configuration after migration
Barzotto & Farias, 2022	Real case study	Deconstructing an application into microservices	CPU doubled after partitioning

3. Problem description

With continuous developments, an evolution of application architectures is observed, where their development is directly related to the increase in software development requirements in which application maintenance will be even easier. The transfer from simple monolithic applications to models containing microservices has brought improvements that are directly related to system performance and CPU consumption management.

As a paper, its purpose is to identify a main problem which is the goal to be able to address how the architecture of the application affects whether it is a monolithic application or with microservices by analyzing the consumption of the processor by subjecting it to loads of different levels and testing them. Microservices as such offer stability even with very high loads, this makes possible the horizontal scaling that it has. But as such they will bring increased CPU consumption under normal load conditions due to the complexity of the communication that these types of applications have. By creating the load which we initialize as the number of threads, several features such as CPU usage, response time and throughput in several groups of loads will be analyzed. The results obtained show that a monolithic application is efficient when there are low loads due to the simple construction in the structure, while if we analyze the results of the microservices application, it shows that high loads due to horizontal scaling will be seen that the processor consumption will have a high cost but not like the monolithic one when there are high loads.

4. Methodology

In this paper, to obtain the final results, an experimental and comparative approach will be used. Existing ready-made applications will be used which can be found on GitHub, one in monolithic form with the access link https://github.com/spring-projects/spring-petclinic and another divided into microservices where the access link is this https://github.com/spring-petclinic/spring-petclinic-microservices. The applications have been selected in order to have comparable functionalities, minimizing the impacts of external factors.

In detail, for each architecture they will undergo these processes:

1. CPU usage under different loads (low load, medium load, heavy load) this one will be monitored all time.

2. Analyze key metrics such as CPU usage.

3. Visually compare results to identify differences.

Finally, the advantages and challenges of each architecture will be discussed depending on the testing scenarios. Experiments will be conducted in controlled environments, using simulated loads (load testing) to measure CPU usage and overall performance.

5. Technologies and tools

The treatment of the topic is based on analyzing how the architecture of the monolithic and microservices application affects, not how we can build such a system. Load testing and monitoring CPU consumption during the execution of these applications.

In addition to the theoretical analysis of this topic, which undoubtedly has many differences and different features, the tests to compare these two architectures will be real measurements. These tests are carried out through two well-known technologies, JMeter which was used to test and stimulate loads and VisualaVM2.2 collects and monitors metrics that change during execution.

Apache JMeter technology is one of the tools used for testing applications, especially web applications, as an open source accessible to all with an easy-to-use logic. In our work, the role of JMeter has been to form test files by generating requests to be able to perform analysis regarding the application's response capacity. The usage approach emphasizes the role of JMeter for simulating loads and measuring response time (Chen et al., 2020).

In addition to JMeter as a second tool, we used VisualVM2.2 as a technology that is based on monitoring the performance of the application under different loads all in real time, especially the CPU consumption that has as its focus. It has a graphical interface that displays this data, where together with JMeter they become a single tool. This kind of tool needed to analyze the performance of distributed systems and to determine critical loads, without interfering with the execution of the application (Szebenyi et al., 2019).

A frequently used approach in the literature for performance evaluation in distributed systems is the combination of load testing with JMeter and metrics collection through VisualVM2.2. This approach enables a balanced examination between resource usage measurements and overall system monitoring, making a contribution to scalability and performance. This technique has been used effectively in studies on the role of system architecture in performance (Agnihotri & Phalnikar, 2018).

6. Results

The results will be realized for both versions of the applications, the monolithic one and the one with microservices, which obtain data for each type of load that the process is subjected to. The tests were obtained locally on the laptop through the JMeter program, which makes it possible to stimulate loads in different amounts, while the monitoring of the impact of the CPU is seen through VisualVM2.2, the data we obtain is in real time.

The metrics in the tests that we use to compare are CPU consumption (average) for a given time and the error rate that occurs between the two applications.

In the analysis of the monolithic application that we have chosen to store locally on the laptop http://localhost:8080/ which looks like in Figure 1:

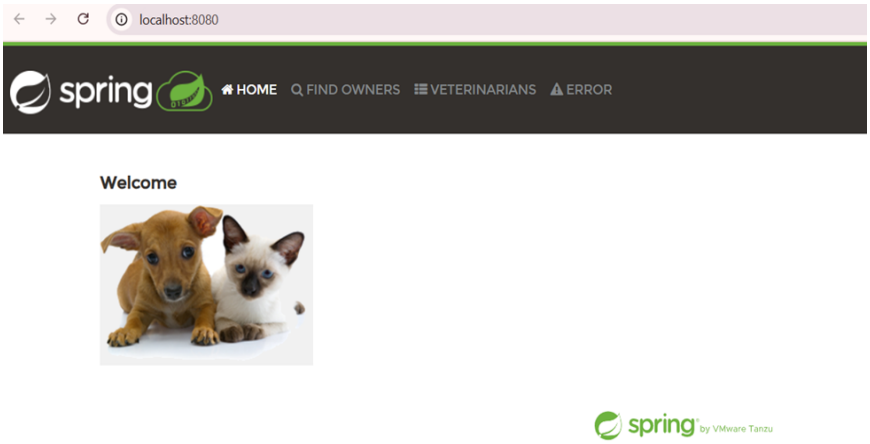

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Fig. 1. Example of a monolithic application

The start of testing applications in Apache JMeter is based on several steps of modeling different load cases. In the test, there are several HTTP requests that are created with the purpose of adding owners and animals to the application in JMeter (Add Pet and Add Owner) these have created the POST method and are sent in this way application/x-www-form-urlencoded, Papplication/x-www-form-urlencoded. Adding timers in this part of the test plays the role of obtaining more realistic results, in this case we used Constant and Random Timer, both of which show the delays that may be on the server. This type of treatment of the topic makes it possible to help in accurately analyzing the performance of the system. The configuration for repetition and load on how the application architecture affects is shown in Figure 2.

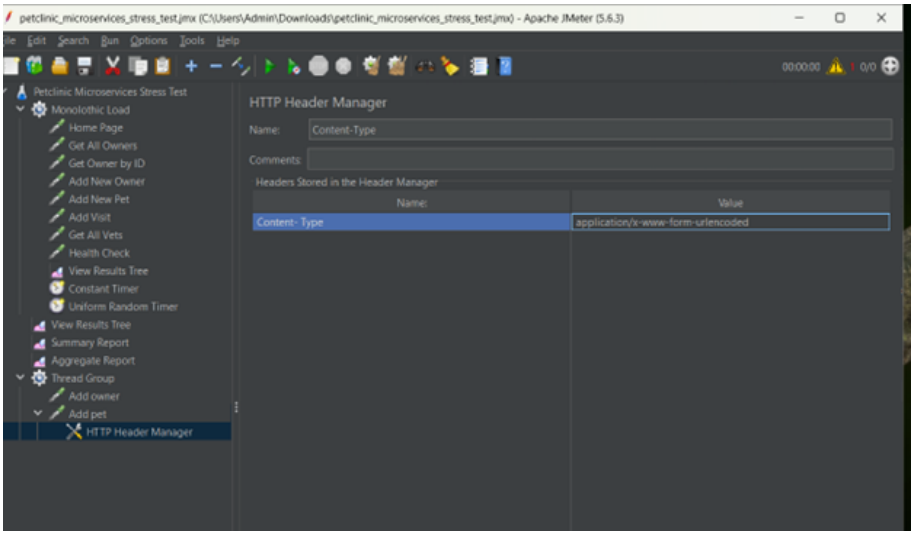

Fig. 2. The configuration for load analysis

The testing part will have several levels (low load, medium load and heavy load). From the thread tests, there will be monitoring of CPU tests for the monolithic application that will be carried out through VisualVM2.2, which can observe CPU consumption in detail.

In the first part of the tests there will be a small number of threads around 10 threads and a time of 10 seconds, this type of execution will belong to the Thread Group "Monolithic Load" which will be performed continuously by making requests to add an "Add Owner" and an "Add Pet".

In this part, 10 users can be executed in parallel and in an infinite Loop which means that of the users that are managed to be executed there will be two calls that will not be interrupted. This type of process that is discussed can be best observed in VisualVM, it will be possible to see a not very rapid increase in CPU consumption but with some peaks which will reach a value of around 1.2 GB, If analyzed further before the memory is cleared. If we look at the number of threads created and those activated, we will see that the testing is intensive, designed in such a way that it can withstand continuous loads in monolithic applications, as can be seen in Figure 3.

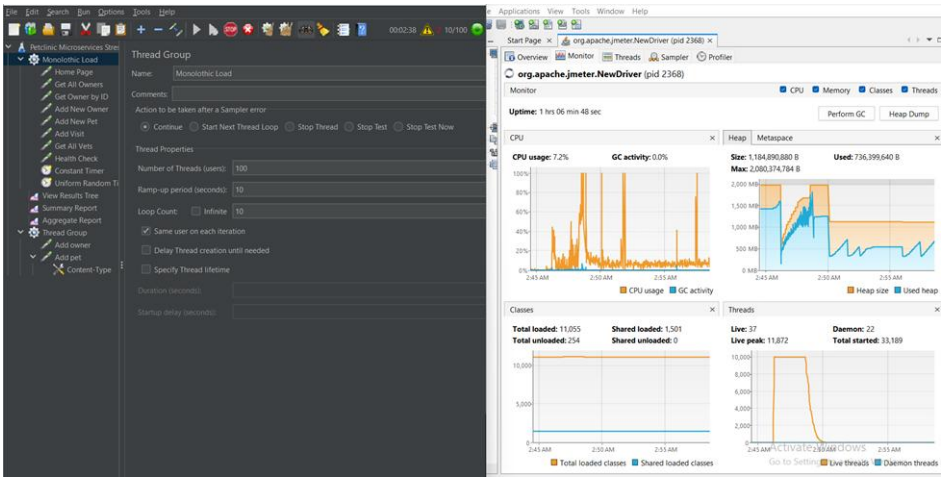

Fig. 3. Threads activated for testing

Initially, the "Monolithic Load" thread group must be created, which will have around 100 users who will use the application in parallel in a time of 10 seconds, for this specific time it is assumed that for a very short time there will be requests in the application. Loop Count has an infinite parameter, forcing each user to call Add Owner and Add Pet.

After the part where the parameters are set in Jmeter and the executions start on the monitoring side in VisualVM, a very high and frequent increase in CPU consumption will be observed, where the culminating points reach over 30% and after a while there will be stabilization. On the other

hand, the heap memory will gradually increase, which will reach values over 1.1GB, after this it will have a more stable level but will still be much higher than in the previous test. If we compare the first tests with the later ones, we can see that there will be 33,000 threads created, which is a very high application load in Figure 4.

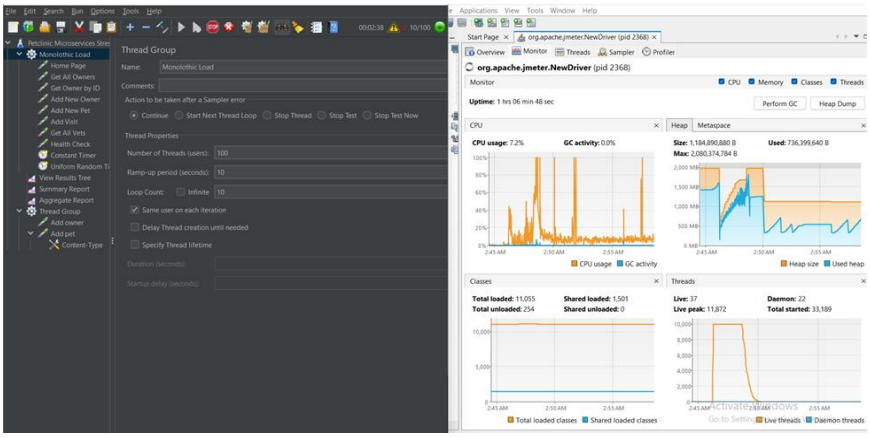

Fig. 4. Creating a large load in a monolithic application

In the third phase of testing, a load of 10,000 users was carried out who operate in parallel in the application through the "Monolithic Load" thread group created by a JMeter with a time of 100 seconds and an endless loop.

If we think of it as a process, it turns out that for a short time 10,000 instances are created that send calls and this part causes the application to be intentionally overloaded. If observed in VisualVM, a very large increase can be observed, and as such it will go from 700MB to more than 1.3GB, by the time the memory starts to be cleared. This view can be seen in Figure 5.

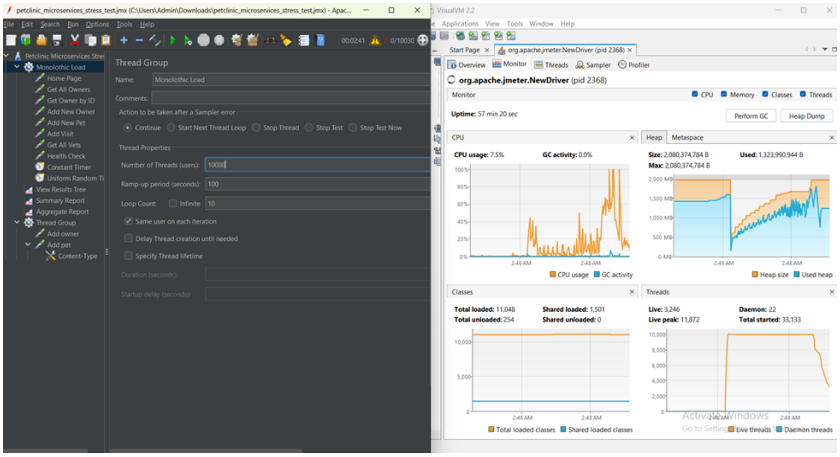

Fig. 5. Progressive increase in heap memory usage

In the second case of the study, the access to the microservices application will be through the laptop locally http://localhost:8080/ as in Figure 1.

The environment in which these tests are carried out, specifically the application with microservices architecture, is stimulated with a load of 10 users who have a limited time of 10 seconds. If we analyze the graph on the left, we have the CPU usage and api-gateway. At the time the tests are carried out, we can see that the most intensive activity usage will have a value of 58.13% and a maximum of 89.2%. But if we compare the graph on the right, it will show the total CPU usage by the system comparing the resources, where the average is somewhere around 3.85% and never exceeds 5.3% of the system. From this data we have obtained, we will see that the distributed architecture for microservices is very efficient against loads as in Figure 6.

Fig. 6. Total CPU usage by the microservice system

In the second part of the tests, which have 100 threads for a time of 10 seconds, we will see that the microservices application will have a very low CPU consumption with an average value of 21.3% and a gateway of 9.80%. While when calculating the total consumption, it will have a value of 1.42%, which shows a very high stability of this type of application without being overloaded, its visualization can be best seen in Figure 7.

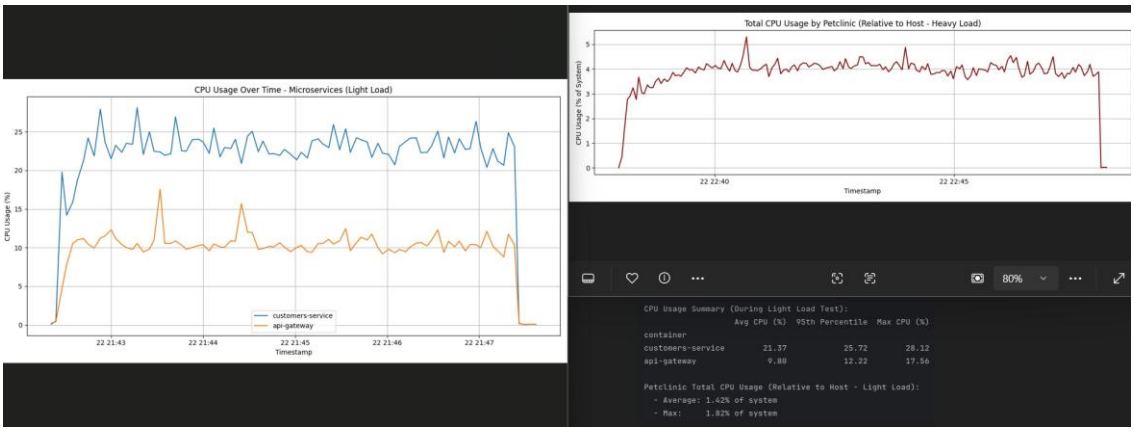

Fig. 7. Good load balancing in microservices architecture

In the third part of the tests with 10000 threads through JMeter which will be a type of distributed load through the application's microservices, it will be noted that the CPU will be used at the service level but will not be available on the host. An average of somewhere around 37.81 in the usage part while the api-gateway somewhere around 18.30%, while when we calculate the total CPU usage it will have a value of 2.55%. If we study more, this result in numerical value is too small for so many users, but in the testing part it will be analyzed that a majority of threads will not send requests simultaneously for certain intervals. This can be seen in Figure 8.

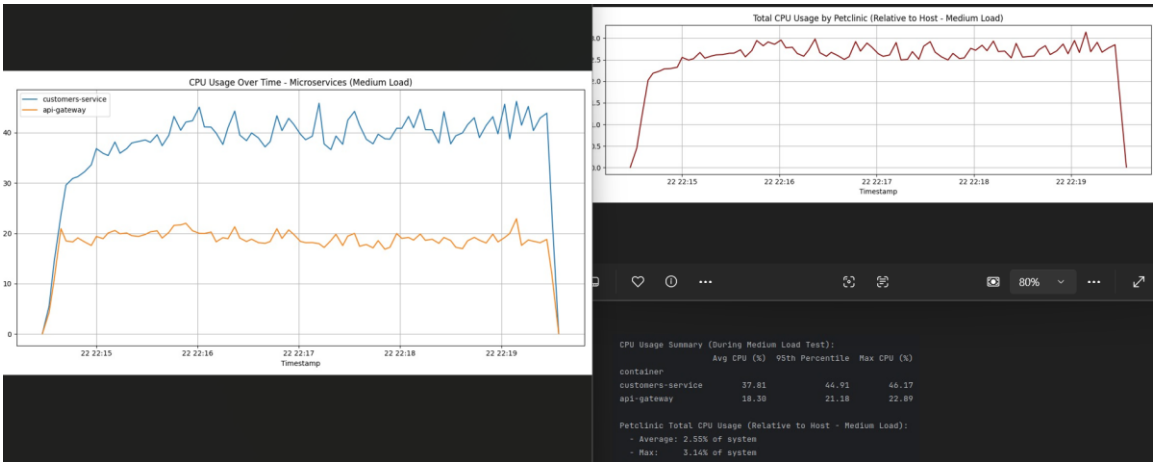

Fig. 8. Moderate CPU usage at the microservices level

While testing both microservices and monolithic applications, we will immediately notice some limitations directly related to CPU and memory consumption, since when the number of users is small, it is mostly observed in the monolithic application in the case of 10, 100 and 10000 threads. While when we compare an application with microservices, what we will notice is that it will cope

with all types of loads and CPU consumption will be more efficient and more stable.

Conclusion & Recommendations

Referring to the way in which the entire problem of this topic is addressed, it is essentially how the application building structure, whether it is with microservices or monolithic, would affect CPU consumption and as a whole how the performance would differ between them. The application given in the two types of architectures but with the same functionality (Spring PetClinic) is subjected to several loads with different values, which JMeter enables for testing under different types of loads, while VisualVM 2.2 was used for monitoring and obtaining concrete values. One conclusion we have reached is that a microservices application has a number of advantages over monolithic ones, especially in load management and CPU consumption. If we increase the number of users through JMeter, it is observed that microservices applications have stability and horizontal scaling capabilities. If compared to a monolithic application, load limitations will appear and with their increase, a rapid increase in CPU, memory and reactive thread consumption will be observed. The results we have achieved represent a kind of importance of which type of architecture not only can we choose but also be suitable by providing operational stability.

The work carried out aims to base the analysis conclusions on the CPU performance as a reference. What can be added more to this work are the analyses that are based on some other performance indicators, for example, it may not be the testing of two types of architectures but it may be the minimization of overhead in distributed architecture applications and what we can use. Another difference may be that since these applications are stored locally on the laptop, they can be tested in cloud environments, whether in AWS or Azure.

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UNIVERSITY OF TIRANA

FACULTY OF ECONOMY

Department of Finance

Scientific Research Competition

JSTOR

Field of study: Human Resource Management

"Unlocking Retention: The Importance of Talent Attraction, Recruitment, and Development in Workforce Stability"

Ilda Braçja

Master of Science in Risk Management

Tiranë, 2025

Abstract

Today, almost all companies have started using the concept of talent management and know that they need to be practical in making a deal with the right skills, knowledge, competencies, behaviors, and relationships to achieve strategic business objectives (Morgan & ardin, 2010).

The main objective of the study is to examine the impact of talent management dimensions: talent discovery, recruitment, and development, on employee retention. To achieve this goal, a research model was built based on a literature review by interviewing 168 employees of different organizations/companies. The findings confirm the impact of talent management dimensions by showing positive associations with employee retention. The more opportunities you give employees to develop, the more engaged they will be in their work. By investing in employee development, engagement, satisfaction, and recruiting the right people, you can reduce turnover rates, foster a positive work environment, and ultimately gain a competitive advantage in attracting and retaining talent.

The sampling selection taken in the study represents a small number, therefore, it cannot be broadly generalized to the entire population, because it is not representative.

Key words: *human resource management, talent attraction, recruitment, development, workforce stability*

1. Introduction

The need for skilled human resources has grown due to globalization and the heightened competition that goes along with it (Schuler & Jackson, 2005). Globally, skilled workers are now a crucial component in the fight for competitive advantage due to the growing importance of knowledge as a resource (Festing, Budhwar, Cascio, Dowling, & Scullion, 2013). Talent has a very broad meaning that provides little hints as to how it might be recognized because it is typically characterized as a collection of personal traits in both practice and academia. However, the terms "high performer" and "high potential" are frequently used interchangeably with the term "talent." Two commonly mentioned components can be distinguished despite this diversity of definitions (Ewerlin, 2013).

Much research offers evidence that HRM can contribute to a sustained competitive advantage by establishing suitable HRM practices to create and develop a high-quality workforce (Lado & Wilson, 1994) (Delery & Doty, 1996). Future research should also investigate which sustainable HRM practices (e.g., work-life balance, employability) have the strongest impact on employer brand-related outcomes. Because employees develop relationships with the organization and with their immediate supervisors (Wayne, Shore, & Liden, 1997), it would also be interesting to investigate the impact of superiors on substance-orientation perceptions. In the theoretical introduction to their study, Klein, Dansereau and Hall (1994) suggested that integrated manufacturing practices within a plant are most likely to be efficacious if job characteristics within the plant are high in complexity, variety, and interdependence. Further, they posited that the relationship between integrated manufacturing practices and job characteristics is moderated by the source of organizational inertia (e.g., plant size). The study's implied level of theory is thus the plant.

Five steps are recommended by Hewitt Associates for creating a *powerful employer brand*: (1) Gain a thorough understanding of your company; (2) establish a "compelling brand promise" for staff that reflects the brand promise for consumers; (3) establish metrics to assess brand promise fulfillment; (4) ruthlessly align all personnel practices to support and reinforce brand promise; and (5) carry out the measure (Berthon, Ewing, & Hah, 2005) Companies with strong employer brands may be able to minimize the cost of hiring new employees, enhance employee relations, boost employee retention, and even pay comparable employees less than those with poorer employer brands, claims Ritson (2002).

Literature Review

Although an organization's formal talent management structure is still in its infancy and has not yet taken shape, it is attempting to incorporate the idea into its competitive advantage plans (Bandari & Migiro, 2015). To ensure efficiency and effectiveness, companies' structures are coordinated, and their operational styles are simplified. Additionally, organizations are concentrating more on output quality, precision, and accuracy. Given these developments, the organization's human resource function now plays a more crucial and accountable role in guaranteeing overall quality management (Bandari & Migiro, 2015). The hiring of skilled employees has made the HR executive's job more important and difficult. Therefore, it is now necessary to update traditional hiring procedures and create a creative, unconventional human resource strategy to guarantee a high-caliber staff that can satisfy the demands of evolving businesses (Bandari & Migiro, 2015).

Instead of concentrating on a small group of alleged high performers, talent management cultivates, uses, and rewards a variety of skills throughout the whole workforce (Drucker, 2015). The only effective strategy to reduce the risks associated with an unpredictable threat environment and a labor market that is becoming more and more competitive is to have a comprehensive and deep talent inventory (Drucker, 2015). Furthermore, talent management is defined as the process of ensuring that the organization/company attracts, retains, motivates, and develops talented people (Cappelli, 2008). It is a set of design processes that ensure that employees are promoted appropriately to available jobs in the organization and that the right person is in the right job, at the right time (Cheloha & Swain, 2005) (Kesler, 2002). According to Williams (2000), a talent is “someone who has consistently high ability and performance, either across a broad range of activities and/or within a specific area of expertise. In addition, this talented employee has high ability in areas of activity that strongly suggest transferable and comparable abilities in other areas where he or she has yet to be tested, even though the individual may not yet have had experience of the latter (for example, potential)” (Williams , 2000, p. 49).

Methodology

Data and sample

This section presents the research methodology used in this study to examine how much impact

the dimensions of talent management: talent discovery, recruitment, and development, have on employee retention. For this study, a survey was conducted among bachelor students, as new employees in the labor market. Data was collected using Google Forms, and a link with the URL of the questionnaire was sent out from February to March 2025. A total of 168 questionnaires were collected.

Measures

The questionnaire was divided into different sections: demographic information; *employee retention* by 5 questions referring to effort by management to minimize the intention of an employee to leave it, *talent discovery* which was measured using 4 questions relating to the process of finding talented employees among qualified applicant by predicting who would do the best job, with *talent development* referring to 5 questions regarding the growth of skills and attitudes and competences, and *talent recruitment* which was found by referring to 4 questions regarding identifying and selecting capable people within the context of organization's being improved or maintained in efforts toward success. Respondents were to indicate on a scale of 1 to 5 on the Likert scale: Totally agree 1; Totally disagree 5.

A total of 168 filled out the questionnaire. Among them, 149 (88.7%) were female students and 19 (11.3 %) were male students.

Table 1. Demographic Profile of Respondents

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Female**	149	88.7	88.7	88.7
	Male	19	11.3	11.3	100.0
	Total	168	100.0	100.0	

Source: Author's work

Analysis and discussion

As indicated by the ANOVA results demonstrate considerable significance for the regression model ($F = 55.790$, $p < .001$), talent management is impacted considerably by the variables: talent

development, recruitment, and discovery. The model expresses that retention is significantly affected by good HR practices, explaining a very large variance in retention. This implies that human resources activities concerning talent acquisition, recruitment, and development significantly correlate with retention outcomes. Therefore, organizations ought to manage such HR activities properly for better retention of employees.

Table 2. ANOVA analysis

Model		Sum of Squares	df	Mean Square	F	Sig.
1	**Regression**	372.789	3	124.263	55.790	.000[b]
	Residual	365.282	164	2.227		
	Total	738.071	167			

a. Dependent Variable: employee retention

b. Predictors: (Constant), talent development, talent recruitment, talent discovery

Source: Author's work

The Model Summary in Table 3 gives critical information on the effectiveness and power of the regression model. The dependent variable of talent management has a high positive correlation with the independent variables of talent development, recruitment, and discovery, highlighted by an R of 0.711. The combined contribution made by the three predictors probably accounts for about 50.50% of the variance in employee retention, according to the R Square of 0.505. The model's sturdiness can also be evidenced by the Adjusted R Square, which has a value of 0.496, which is significantly lower but indicates good model fit. Thus, the model is relatively strong from all perspectives. It states that talent discovery, recruitment, and development significantly predict employee retention for approximately half of what is deemed the large social sciences.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.711[a]	.505	.496	1.49242

a. Predictors: (Constant), talent development, recruitment, discovery

Source: Author's work

The correlation analysis provides vital insights into the relationships among the three major research variables, namely, talent development, talent recruitment, and talent discovery. The most interesting fact here is that talent discovery and talent development are positively and significantly associated (r=0.250, p=0.001). According to this research, the method of developing these people after joining the company improves; hence, a company has more excellent ways for locating or discovering possible candidates. This association makes sense and is strategically significant: firms will better provide focused enhancement opportunities if the successful contacts manage to find people who share their objectives and culture. These people are the ones who will most probably succeed and gain from development and hence add value to the company's success. Therefore, this association adds authority to the statement that the successful growth of employees depends on the efficient acquisition of talent.

On the other hand, "talent discovery" and "talent recruitment" have a negative (r = -0.135) and non-significant (p = 0.081) association. Even though the association is small, the direction is a little surprising because one would think that improved candidate discovery would have a positive correlation with recruiting efforts. However, it may be that some businesses have discrepancies between the sourcing and recruiting stages that might account for this. Strong candidate identification efforts, for instance, might not result in effective hires if there are structural, procedural, and philosophical differences in hiring that are divergent from the methods used to locate candidates. This raises the question that perhaps these two stages can function independently in some organizational makeup, as well as that the recruiting and HR sourcing teams need to better coordinate.

While this indicates a slight positive trend, the relationship between "talent recruitment" and "talent development" is weak and not significant ($r = 0.134$, $p = 0.083$). This may indicate a more general problem: organizations may be treating recruitment and development as distinct HR functions rather than as a continuous process in the employee lifecycle. At best, the recruitment process should have long-term growth goals, identifying candidates based on current needs, but also regarding their future potential. The poor correlation may indicate that HR departments must better intertwine their hiring and employee development efforts to keep congruence in workforce planning.

In short, correlation results provide compelling evidence for the link between recognizing and developing talent, hence the justification for funding effective sourcing approaches as the bedrock for growth. But the weak or non-significant correlations between the other variable pairs seemed to point to possible pitfalls in HR practices, also indicating that a better strategic alignment in hiring with development efforts could yield a more effective and cohesive HR management.

Table 4. Correlations

		Talent discovery	**Talent recruitment**	**Talent development**
Talent discovery	Pearson Correlation	1	-.135	.250**
	Sig. (2-tailed)		.081	.001
	N	168	168	168
Talent recruitment	Pearson Correlation	-.135	1	.134
	Sig. (2-tailed)	.081		.083
	N	168	168	168
Talent development	Pearson Correlation	.250**	.134	1
	Sig. (2-tailed)	.001	.083	
	N	168	168	168
**. Correlation is significant at the 0.01 level (2-tailed).				

Source: Author's work

Talent discovery, with an unstandardized coefficient of B = 0.986 and a Beta = 0.667, has a positive and significant impact on retention. The p-value of 0.000 and a t-value of 11.580 indicate that this relationship is highly significant. This suggests that applying efficient techniques to discover and recruit the best candidates significantly enhances retention. It is said that when someone fits well with a job position and with company culture from the beginning, they are likely to stay for the long haul. Thus, business stability can be influenced directly through investing in intelligent personnel search and selection methods.

B = 0.357, Beta = 0.432, and a t-value of 7.669 indicate that the variable talent recruitment also has a positive and significant influence on retention. This means that, although the effect is less pronounced than the effect of talent discovery, better hiring practices do contribute to elevated employee retention. One possible explanation is that clear, effective, and engaging selection procedures build expectations and trust-based commitment. Following a positive hiring experience, employees are likely to feel valued and respected, which contributes to their retention.

Retention is significantly impacted negatively by talent development, as assessed by a t-value of -4.596, B = -0.238, and Beta = -0.265. Considering the idea that development generally is an excellent retention trigger, this finding may seem surprising at first. However, the finding reveals that in some corporate environments, development initiatives do not necessarily align with the interests or career paths of employees. If development programs are too generic, poorly implemented, or create an imbalance between skill enhancement and employment opportunities, they may very well contribute to turnover by pushing employees to look for greener pastures. The finding accentuates how vital strategic development planning is to ensure that development opportunities are relevant and aligned to career advancement within the same organization. Talent discovery and recruitment, this regression study highlights the importance of hiring and talent acquisition processes, which, conversely, positively affect retention. Conversely, the negative effect of talent development warrants scrutiny on the planning and implementation of development programs. This means that retention is not guaranteed by development alone; the quality, relevance, and association of development with internal advancement are of utmost importance. Thus, HR managers should also focus on not only providing growth opportunities but also ensuring that they yield real career benefits for the company.

Table 5. Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	2.190	.968		2.264	.025
	Talent discovery	.986	.085	.667	11.580	.000
	Talent recruitment	.357	.047	.432	7.669	.000
	Talent development	-.238	.052	-.265	-4.596	.000
a. Dependent Variable: Employee retention						

Source: Author's work

Conclusion & Recommendations

This study examined how talent management components—talent development, recruiting, and discovery—affect employee retention in a sample of recent graduates, especially bachelor's degree candidates. The results highlight the important impact that good personnel management strategies have on employee retention, which is a crucial result in the cutthroat, international workplace of today.

The regression analysis's findings demonstrate a good model fit, with the variables accounting for around 50.5% of the variation in staff retention. The predictor that had the biggest beneficial impact on retention was talent identification. This implies that finding the proper applicants—those who fit the organization's culture and values in addition to meeting the requirements—can result in increased long-term commitment. Employee engagement and retention are higher when they believe their skills align with their responsibilities and the organization's overarching goals. As the foundation of effective human resource management, this research highlights the necessity of strategic and data-driven approaches to early talent identification.

Though not as strongly as talent discovery, talent recruiting also showed a statistically significant and favorable correlation with retention. This demonstrates how open, inclusive, and well-organized recruiting procedures may promote involvement and trust right from the start of the job relationship. In addition to attracting the best candidates, a successful hiring process also establishes the culture of the workplace and fosters a sense of loyalty inside the company. Remarkably, there was a negative and substantial correlation between employee retention and talent development. This highlights the difficulty of putting development plans into action, even if it goes against the widely held belief that chances for growth typically boost loyalty. According to the findings, employees may get dissatisfied with poorly coordinated or generic development programs, particularly if they believe their personal development is not resulting in significant professional advancement within the company. Development initiatives that aren't transparent, personalized, or linked to internal mobility may inadvertently inspire staff members to look for better chances elsewhere. This emphasizes how important it is for HR departments to make sure that development programs are well thought out, pertinent, and connected to distinct career paths within the company.

Additionally, the correlation analysis provided insightful information. Talent development and talent discovery were found to be significantly positively correlated, suggesting that companies who are successful at spotting talent are also likely to be successful at nurturing it. The weak or non-significant correlations between the other pairings, such as recruitment-development and discovery-recruitment, indicate that some businesses could handle these tasks separately, which could jeopardize the strategic coherence of talent management. The results show that, whereas talent acquisition procedures like recruiting and discovery greatly improve employee retention, development plays a more complex function that requires strategic alignment. In addition to improving their hiring procedures, organizations looking to increase retention should make sure that development programs are tailored to each employee's needs, career-focused, and successfully carried out. All things considered, maintaining a competitive and devoted staff in the contemporary labor market requires comprehensive, careful personnel management methods that cover the employee's lifetime.

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UNIVERSITY OF SHKODRA "LUIGJ GURAKUQI"

FACULTY OF EDUCATIONAL SCIENCES

Department of Biology - Chemistry

Scientific Research Competition

JSTOR

Field of study: Distribution of Lamiacea Family

"Distribution of Main Species of the Lamiaceae family in the Shiroka Region"

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Bachelor of Biology - Chemistry, I- st Year

Shkodër, 2025

ABSTRACT

Purpose – The purpose of this study is to identify the species of the *Lamiaceae* family in the Shiroka region, through the study of their distribution and density in this area. The Lamiaceae family is known for its representative species of aromatic and medicinal plants. This study focuses on the distribution and diversity of the main species of this family in the area of Shiroka, a region known for its rich biodiversity. In this study, 11 species of the Lamiaceae family were found. According to the A-D coefficient, the most important and widespread species are; Sage (Salvia officinalis), Oregano (Origanum vulgare), Mint (Mentha sp.), Lisri (Thymus sp.), etc., whose presence greatly favors an increase in the number of medicinal and aromatic species. Comparing the number of species of the Lamiaceae family in Albania, our study area contains 6.3% of the species. Knowledge of the *Lamiaceae* plants in the Shiroka region will be a unique study that will add information about the vegetation of the area, especially its medicinal and aromatic plants. This study can serve as a guide for students who want to study in the field of the environment, as well as for the local community. The objectives of this study are summarized as follows:

To identify and document the main species of the Lamiaceae family in the Shiroka region.

To determine their distribution and density using the Abundance-Dominance coefficients.

Methodology – For the realization of this study, three study areas were considered. The selection of survey areas was done using the "Route" method, according to which we walked in the field and set up to conduct surveys when changes in the floristic composition were observed.

The method used for selecting the size of the survey areas was the "Minimum Area" method. This method determines the smallest area in which the majority of species of a plant association can be found. The dimensions of the surveys vary according to life forms

1. Introduction

1.1 History of the *Lamiaceae* Family

The Lamiaceae family, also known as the mint family, is one of the largest and most important families of aromatic plants. It includes over 236 genera and around 7,000 different species, which are distributed worldwide. These plants are known for their uses in culinary, medicinal, and cosmetic applications, as well as for their ecological and economic values. It was first identified and classified by the French botanist Antoine Laurent de Jussieu in 1789, in his famous work "Genera Plantarum." Jussieu divided the family into several genera based on the morphological characteristics of the plants, such as flower structure and leaves (Harley et al. 2004).

The Lamiaceae family has a long history of human use. Since ancient times, plants of this family have been used for medicinal, culinary, and aromatic purposes. In ancient Egypt, Greeks, and Romans, plants such as basil (Ocimum basilicum), oregano (Origanum vulgare), and mint (Mentha sp.) were used to treat various diseases and to flavor foods and beverages. Over time, these plants spread and were cultivated worldwide, becoming part of the cultural and culinary traditions of many peoples (Laërence, 2006).

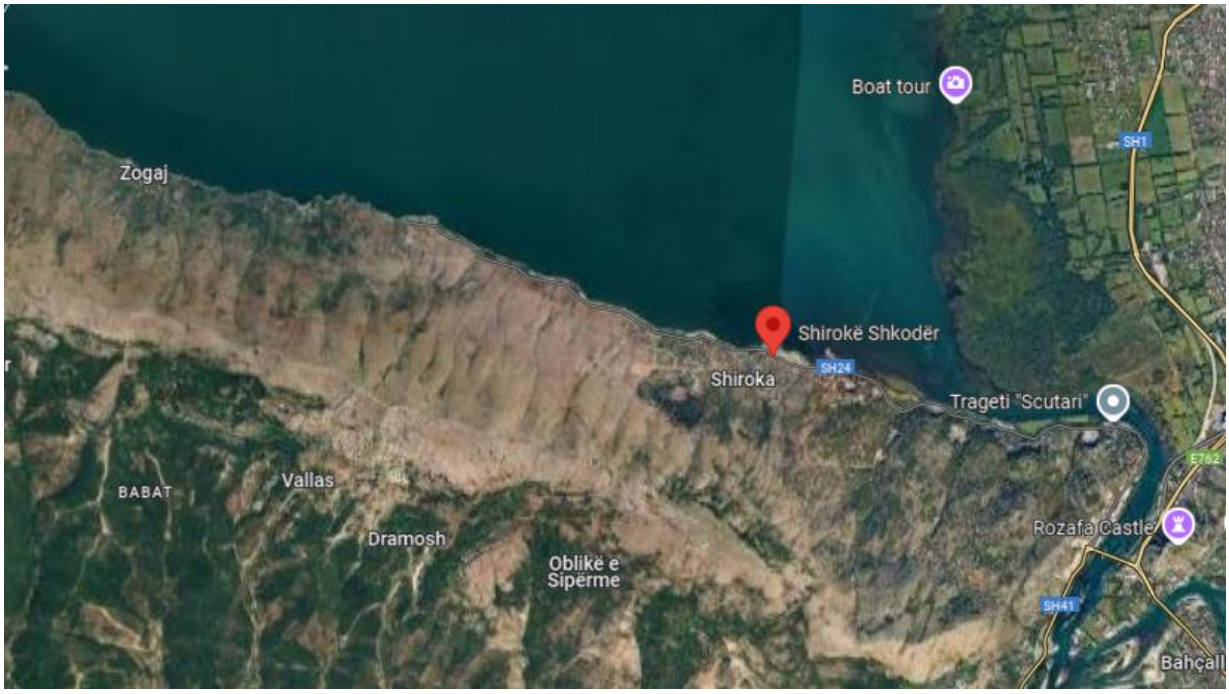
Characteristics of the Lamiaceae Family

Plants of the Lamiaceae family are known for their strong aroma, which comes from the presence of essential oils in their leaves and flowers. These oils have antibacterial, antifungal, and antiviral properties, making them useful in medicine and the cosmetics industry. Additionally, Lamiaceae plants have significant ecological, economic, and cultural importance.

Ecology: Plants of this family are distributed worldwide but are particularly common in Mediterranean regions. They play an important role in local ecosystems, serving as food sources for many pollinating insects and helping to maintain biodiversity.

Economy: Many plants of the Lamiaceae family have high economic value. For example, oregano, basil, rosemary, and lavender are cultivated worldwide for the production of essential oils and for use in the food industry. The production and trade of these products are an important source of income for many countries.

Culture: Lamiaceae plants hold a special place in the cultures and culinary traditions of many peoples. They are used to flavor foods and prepare various teas. In some cultures, these plants are also used for ritual and religious purposes (Cantino et al. 1992).



1.2 Research Problem

The study of the distribution and diversity of species of the Lamiaceae family in the Shiroka region aims to address some fundamental questions and research issues related to the diversity, use, and conservation of these plants. To clearly define the research problem, it is important to analyze some key aspects:

- Diversity and Distribution: What are the main species of the Lamiaceae family found in the Shiroka region? How are these species distributed in different areas of Shiroka?

- Influencing Factors: What are the environmental and anthropogenic factors that influence the distribution and diversity of these species in Shiroka?

- Traditional and Contemporary Use: How are plants of the Lamiaceae family used by the local community in Shiroka? What are the traditional and contemporary uses of these plants?
- Risk and Conservation: What are the main risks that threaten the diversity and survival of these species in the Shiroka region? What conservation measures are needed to protect these species?

Formulation of the Research Problem

Based on these aspects, the research problem can be formulated as follows:

Research Problem: Identification and documentation of the diversity and distribution of the main species of the Lamiaceae family in the Shiroka region, through the study of their density.

Influencing Factors:

Favorable climatic conditions allow for steady and rapid plant growth.

Diversity of terrain provides different habitats that support various species of Lamiaceae.

Lake water and humidity help maintain moist and nutrient-rich soils, which are essential for plants of this family.

2. GENERAL CHARACTERISTICS OF PLANTS IN THE LAMIACEAE FAMILY

2.1 History of the Use of Plants in the Lamiaceae Family

These plants have been used in various cultures for generations for therapeutic, culinary, and ritual purposes. Here is a summary of the history of the use of this plant family:

Ancient Mediterranean:

Plants of the Lamiaceae family have a long history of use in the ancient Mediterranean cultures of Egypt, Greece, and Rome.

In ancient Egypt, aromatic waters such as mint and thyme were used to treat diseases and to prepare perfumes and flavored waters.

In ancient Greece, famous writers and physicians such as Hippocrates and Theophrastus wrote about the medicinal qualities of plants like oregano and mint.

Traditional and Folk Medicine:

In medieval Europe and later, plants of the Lamiaceae family continued to be used for medicinal purposes by traditional healers and the general population.

Plants such as rosemary, oregano, and sage were used to treat various health problems, including infections, stomach issues, and nervous system disorders.

Culinary Use:
Aromatic plants of the Lamiaceae family are widely used in the cuisines of many cultures to add unique flavors and aromas to dishes.Leaves such as mint and oregano are often added to various dishes

like soups, salads, main courses, and baked foods to enhance flavor.Some plants can also be used to make aromatic teas and infusions.

Medicinal Use:
Plants of the Lamiaceae family have been used for medicinal purposes for thousands of years.Some plants have antibacterial, anti-inflammatory, and antispasmodic properties and can be used to treat various health problems such as infections, stomach pain, and respiratory issues.Extracts and infusions of plants can be used to treat these conditions and improve overall well-being.

Aromatic Use:
Essential oils of plants in the Lamiaceae family are highly valued for their pleasant aroma and therapeutic properties.These oils can be used to scent environments, for air diffusion, or to create body and home care products with a pleasant and relaxing aroma.

Cosmetic Use:
Essential oils of plants in the Lamiaceae family are often used in cosmetic products to add a pleasant aroma and skin benefits.They can be added to skin care products such as moisturizing creams, body lotions, and soaps to provide a fresh aroma and therapeutic benefits.

The history of the use of the Lamiaceae family shows a close connection between plants and human culture through the centuries. This plant family has been and continues to be an important source of food, medicine, and culture for communities around the world. (Quezel & Santa 1963).

2.2 Chemical Composition of Plants in the Lamiaceae Family

Essential Oils: Essential oils are responsible for the characteristic aroma of many plants in this family. In some plants, such as mint (Mentha sp.) and oregano (Origanum vulgare), essential oils contain major components such as menthol, carvacrol, and cineole, which have antimicrobial, anti-inflammatory, and other health benefits.

Flavonoids: Flavonoids are a broad group of chemical compounds found in many plants, including some species of the Lamiaceae family. These compounds have antioxidant and anti-inflammatory effects and are linked to numerous health benefits.

Tannins: Tannins are a group of chemical compounds often found in the leaves and other parts of plants in the Lamiaceae family. These compounds have astringent properties and can be useful for treating conditions such as diarrhea and lung inflammation.

Organic Acids: Organic acids, such as citric acid and malic acid, are also present in some plants of this family. These acids have various effects, including aiding digestion and maintaining a balanced pH in the body.

Alkaloids: Some plants in the Lamiaceae family contain alkaloids, which are responsible for some of their therapeutic effects. For example, some species of mint contain menthol, which can have cooling and pain-relieving effects.

Menthol: This is a chemical compound found in many plants of the Lamiaceae family, such as mint. The chemical structure of menthol is simple and contains a hydroxyl group (-OH) in a specific position on a carbon chain.

Carvacrol: This is another common chemical compound found in the essential oils of some plants in the Lamiaceae family, such as oregano. Carvacrol has an aromatic structure and contains a hydroxyl group (-OH) and a methyl group (-CH3) on a carbon atom attached to an aromatic carbon.

Cineole: This compound is found in sage (Salvia officinalis), for example. Cineole is a monoterpene that influences the aroma and quality of sage. Its chemical structure includes an oxygen group in a specific position on a carbon chain.

These are just some of the important chemical compounds found in plants of the Lamiaceae family. The content of chemical compounds varies depending on the type of plant and growing conditions, and many of these plants have been used for therapeutic, culinary, and other purposes for centuries. Their common components are diterpenoids. (Bhatt et al. 2012).

2.3 Collection, Drying, and Storage of Plants in the Lamiaceae Family

The collection, drying, and storage of plants in the Lamiaceae family should be done carefully to ensure that their quality and aromatic and medicinal properties are preserved.
Collection:

Choosing the Right Time: Plants should be collected at the appropriate time of the season to ensure maximum aromatic and therapeutic potency. For example, aromatic plants like mint are usually collected during the flowering period when their essential oils are at their peak.

Collection Method: Plants can be collected by cutting branches. It is important to ensure that the plant is not damaged too much during the collection process.

Drying:

Air Drying: Plants can be air-dried by leaving them in a dry and well-ventilated place, away from direct sunlight. This can be a good option for thicker plants that can easily fall off the branches.

Storage:

Storing in Ambient Conditions: After drying, plants can be stored in a closed notebook or container in a dry and cool place for short periods. Make sure to avoid moisture to prevent the risk of dust and contamination.

Storing at Low Temperatures: Some plants can be stored better at low temperatures.

Using Sealed Containers: Use a notebook or airtight bag to store plants for longer periods.

Lamiaceae as Antioxidants

With the hope of finding natural antioxidants for the food industry and, consequently, effective therapy for many people today. Plant antioxidants are very significant as their presence in the human diet can help the body neutralize free radicals and reduce oxidative stress damage. In contrast, synthetic antioxidants have potential activity as cancer-causing agents. The antioxidant activity of phenolic compounds depends on their structure and nature. Edible antioxidants commonly found in plants include ascorbic acid, tocopherols, carotenoids, and some phenolic compounds such as phenolic acids, flavonoids, and tannins. Phenolic acids, such as caffeic, ferulic, and vanillic acids, are known as natural antioxidants widely distributed in the plant kingdom. Furthermore, natural polyphenols, whose antioxidant activities have been known for a long time, are tannins. Additionally, some studies have found that low amounts of tannins (0.15-0.2%) in the diet can be beneficial for human health and create a more astringent taste, while at higher concentrations, they inhibit enzyme digestion and reduce the bioavailability of iron and vitamin B12. Most Lamiaceae sources of antioxidants belong to the Nepetoideae subfamily, including basil, lemon balm, mint, oregano, rosemary, sage, etc. They contain rosmarinic acid and are often rich in volatile aromatic terpenes. Moreover, rosemary extracts were the first natural antioxidants marketed. In one study, it was shown that thyme, sage, rosemary, and basil had the highest antioxidant capacity among the studied plants. In addition to thyme, rosemary, and sage, mint, lemon balm, and basil also contain a significant amount of phenolic compounds with strong total antioxidant activity and DPPH radical scavenging activity. The aforementioned species are among the most frequently studied species of the Lamiaceae family, and their antioxidant activity has been demonstrated in numerous studies.

Lamiaceae as Antimicrobial Agents

Due to the widespread use of commercial antimicrobial drugs, resistance to many drugs has developed in both human pathogenic microorganisms and plants. Therefore, scientists are trying to find new antimicrobial sources from plants that can be used in the food, pharmaceutical, and medical industries. It is well documented that most of the studied species belonging to the Lamiaceae family have significant biological and pharmacological activities, also due to the triterpene acids they exhibit, which have anti-inflammatory, antiviral, cytotoxic, and cardiovascular effects. One of the most famous Lamiaceae plants rich in ursolic acid is rosemary, which has been the subject of numerous studies. Some studies show that basil (Ocimum gratissimum L. and Ocimum kilimandscharicum) has

antimicrobial activity against bacteria (E.coli, S. aureus, S. typhimurium) and fungal strains (C. albicans and A. niger). Lemon balm, mint, basil, Brazilian boldo (Plectranthus barbatus Andreës), and rosemary were the subject of a study and showed antibacterial activity against Gram-positive and Gram-negative bacterial strains. (Caroć-Stanko et al, 2016)

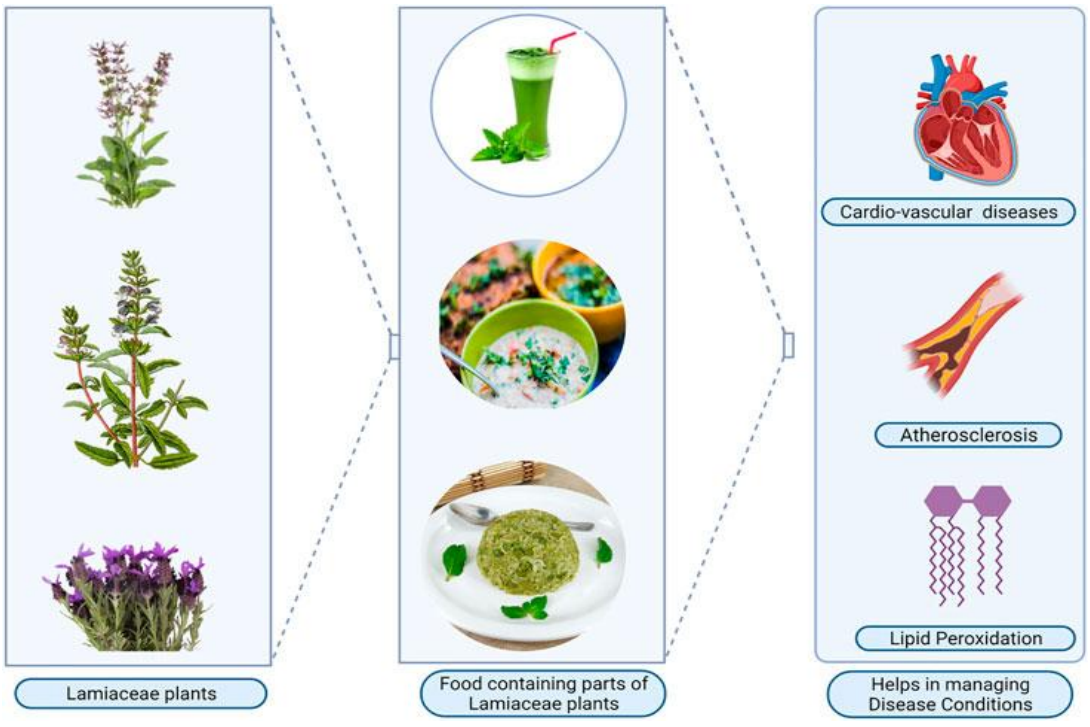
3.METHODOLOGY

Field Expeditions

For the realization of this study, three study areas were considered. During the preparatory phase for the successful conduct of the expeditions, the following were used: herbarium sheets, herbarium press, polyethylene bags, a small shovel, station data sheets, excursion flora, a camera, and the "Picture this" application for initial plant identification. The expeditions were conducted during the period April-May-June when the vegetation is most representative.

Selection of Survey Areas

The placement of the survey positions was carried out during the observation of the presence of species. The surveys were guided by the homogeneity of the vegetation, so that it would be as representative as possible. Anthropogenic environments were avoided, although in our area it was not entirely possible. The selection of survey areas was done using the "Route" method, according to which we walked in the field and set up to conduct surveys when changes in the floristic composition were observed.



The method used for selecting the size of the survey areas was the "Minimum Area" method. This method determines the smallest area in which the majority of species of a plant association can be found. The dimensions of the surveys vary according to life forms (Mueller-Dombois & Ellenberg 1974, Koçi 2016).

Data Collection and Processing

Elements of the Survey Sheet

In each survey plot, all present plants were listed. Alongside them, other station characteristics were also noted. The selection of survey areas was done in such a way as to include areas where the vegetation is most complete, with minimal anthropogenic interference. In each area, 5 surveys were conducted in nearby areas. The survey sheet with its main elements is presented below.

During the expeditions, care was taken to ensure that the collected plants were as complete as possible, equipped with underground apparatus, so that they could be identified as easily as possible. The plants collected in the field were accompanied by a small sheet with station data.

Elements of the Survey Sheet

Surveyor: I. Zmijanej Survey Date: 08/05/2024 Survey Number::

Survey Location:: Shirokë

Species name	***Parc.1***	***Parc. 2***	***Parc. 3***	***Parc. 4***	***Parc. 5***
	A-D	***A-D***	***A-D***	***A-D***	***A-D***

Filling Out the Survey Sheet

In compiling the list of species with binomial scientific names, all vascular plants were included, categorized into trees, shrubs, and herbaceous plants. For each species, the abundance-dominance coefficient (A-D) was assessed according to Braun-Blanquet, which is given in the following scales:

r - isolated individuals;

+ - rare or very rare individuals, with very low coverage;

1 - numerous individuals, but with low coverage;

2 - numerous individuals, or covering at least 3-5% of the sample area;

3 - number of individuals covering 26-50% of the sample area;

4 - number of individuals covering 51-75% of the sample area;

5 - number of individuals covering 76-100% of the sample area.

Species Identification

Species identification was done using guides to the national flora:

Flora of Albania (Paparisto et al. 1988, Qosja et al. 1992, 1996, Vangjeli et al. 2000),

Excursion Flora of Albania (Demiri 1983), and Field Guide to the Flora of Albania (Vangjeli 2003).

4.STUDY RESULTS

4.1 Diversity of *Lamiaceae* Plants

In the Shiroka region, there are several main species of the *Lamiaceae* family that are present. Some of the main species of this family that we found **(11 species)** in our study are:

Species name	***Parc.1***	***Parc. 2***	***Parc. 3***	***Parc. 4***	***Parc. 5***
	A-D	***A-D***	***A-D***	***A-D***	***A-D***
Stachys germanica	1	1	1	1	2
Origanium vulgare	1	1	5	5	5
Rosmarinus officinalis	1	1	2	1	1
Mentha aquatica	5	4	4	5	5
Clinopodium nepeta	3	4	4	4	4
Teucrium polium	2	3	2	3	4
Melissa officinalis	4	4	4	4	5
Salvia officinalis	5	5	5	5	5
Phlomis fruticosa	5	4	4	4	5
Thymus pulegioides	5	4	4	5	5

Teucrium scordium	4	3	3	3	4

Table 1. Summary of Survey Sheets from the Study Area

Among the species with the highest A-D coefficient, we can mention:

Sage (*Salvia officinalis*): Sage is a well-known species of the Lamiaceae family and is known for its medicinal and aromatic properties. It can be found in various areas of Shiroka, especially in forests and dry pastures.

Oregano (*Origanum vulgare*): Oregano, also known as "wild marjoram," is another well-known species of the Lamiaceae family that can be found in Shiroka and other regions of Albania. This aromatic plant usually grows in forests and open fields.

Mint (*Mentha sp*.): Mint species are known for their fresh aroma and are widely used in gastronomy and for medicinal purposes. They can be found in various areas of Shiroka, especially near water sources and wet pastures.

Thyme (*Thymus sp*.): Some species of Thymus are known for their medicinal and aromatic properties. These can be found in pastures and open fields in Shiroka.

The distribution of these species of the Lamiaceae family in the Shiroka region may vary depending on the habitat and other environmental conditions. For example, species like sage and oregano prefer dry and sunny areas, while mint and thyme prefer a more humid environment. Thus, they can be found in open fields, wet pastures, and near water sources. Depending on the characteristics of these plants and their habitat preferences, they can be distributed in different ways throughout the Shiroka region.

Comparing the number of species of the Lamiaceae family in Albania, which is 176 (Salihaj et al. 2022), our study area contains 6.3% of the species.

Species of the *Lamiaceae* Family in the Shiroka Region (Pictures)

Melissa officinalis

Mentha aquatica

Teucrium polium

Clinopodium nepeta

Rosmarinus officinalis

Origanium vulgare

Teucrium scordium

Phlomis fruticosa

Salvia officinalis

Stachys germanica

Thymus pulegioides

Conclusion & Recommendations

1. The Shiroka region has a very favorable geographical position and climatic conditions for the development of vegetation, especially for the *Lamiaceae* family.
2. From this study, we have identified a total of **11 plant species of the *Lamiaceae* family** in three stations in the Shiroka region.
3. According to the A-D coefficient, the most important and widespread species are: **Sage (*Salvia officinalis*), Oregano (*Origanum vulgare*), Mint (*Mentha sp.*), Thyme (*Thymus sp.*)**, etc., whose presence greatly favors an increase in the number of medicinal and aromatic species.
4. Comparing the number of species of the *Lamiaceae* family in Albania, which is 176, our study area contains 6.3% of the species.

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