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ORIGINAL ARTICLE

Determinants of alignment level with public health risk management under COSO – ERM

Carla Janaína Ferreira Nobre Rêgo[1]
https://orcid.org/0000-0002-7730-1624
Email: carla.nobre@ufrn.br

Jeronymo José Libonati[2,3]
https://orcid.org/0000-0001-9164-9144
Email: jeronymo.libonati@ufpe.br

[1]Universidade Federal do Rio Grande do Norte, Centro de Ciências Sociais Aplicadas, Departamento de Ciências Contábeis, Natal, RN, Brazil
[2]Universidade Federal de Pernambuco, Centro de Ciências Sociais Aplicadas, Departamento de Ciências Contábeis e Atuariais, Recife, PE, Brazil
[3] Universidade Federal do Pernambuco, Centro de Ciências Sociais Aplicadas, Laboratório de Governança, Gerenciamento de Riscos e Conformidade, Recife, PE, Brazil

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Correspondence address

Carla Janaína Ferreira Nobre Rêgo
Universidade Federal do Rio Grande do Norte,
Centro de Ciências Sociais Aplicadas, Departamento de Ciências Contábeis
Avenida Senador Salgado Filho, s/n – CEP: 59078-970
Lagoa Nova – Natal – RN – Brazil

ABSTRACT

This article aimed to analyze the determinants of alignment level of risk management practices in Brazilian municipal health management, based on the perception of municipal managers, using the Committee of Sponsoring Organizations of the Treadway Commission – Enterprise Risk Management (COSO – ERM) as a reference. This study presents theoretical and practical contributions by identifying the determinants, socioeconomic characteristics, and manager profile influencing the alignment level with municipal health risk management based on the COSO framework. In Brazilian public sector, the literature on risk management is still incipient. References are often drawn from business-oriented research, with the adoption of standards occurring coercively due to academic or private institutional pressures. The accounting literature has advanced through the proxy used to measure health risk management. Its adoption improves governance and management practices in health and education. The study used a survey based on COSO – ERM components, through the Likert scale to determine the dependent variable: the level of alignment with risk management. Additionally, a Tobit regression model with secondary variables was applied to test hypotheses regarding managers' profiles and municipal socioeconomic characteristics. The survey results have showed that Brazilian municipalities have an 80% agreement with public health risk management practices proposed by COSO – ERM. Hypotheses related to effectiveness, 1 (health), 2 (education), and 3 (governance in information technology), were not rejected. Hypotheses 4 (indebtedness) and 5 (financial dependency) were rejected; hypothesis 6 (manager profile variables) was not rejected. This indicates that the manager's profile is a determinant for aligning health risk management practices, while socioeconomic characteristics of indebtedness and financial dependence have a significant inverse influence.

Keywords: risk management, municipal public health, COSO – ERM.

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Determinantes do nível de alinhamento ao gerenciamento de riscos na saúde pública sob o COSO – ERM

RESUMO

O objetivo deste artigo foi analisar os determinantes do nível de alinhamento das práticas do gerenciamento de risco na gestão de saúde municipal brasileira, a partir da percepção de gestores de prefeituras, tendo como referência o Committee of Sponsoring Organizations of the Treadway Commission – Enterprise Risk Management (COSO – ERM). O estudo apresenta contribuições teóricas e práticas ao mostrar os determinantes, características socioeconômicas e perfil do gestor, sobre o nível de alinhamento ao gerenciamento de risco na saúde municipal, conforme o framework COSO. No setor público brasileiro, a literatura sobre gerenciamento de riscos é incipiente, sendo utilizadas como referências, pesquisas voltadas ao campo empresarial, ocorrendo de maneira coercitiva a adoção de padrões por pressões acadêmicas ou instituições privadas. A literatura contábil avançou por meio da proxy utilizada para mensurar o gerenciamento de riscos na saúde, sua adoção melhora a governança e suas práticas de gestão em saúde e educação. O estudo utilizou-se de uma survey baseada nos componentes do COSO – ERM, por meio da escala likert, fornecendo a variável dependente, o nível de alinhamento de gerenciamento de riscos. Além de um modelo de regressão Tobit, com variáveis secundárias coletadas para testar as hipóteses sobre o perfil dos gestores e características socioeconômicas municipais. Os resultados da survey evidenciaram que municípios brasileiros apresentam 80% de concordância com as práticas de gerenciamento de riscos em saúde pública propostas pelo COSO – ERM. As hipóteses que tratavam sobre a efetividade, 1 (saúde), 2 (educação) e 3 (governança em tecnologia da informação), não foram rejeitadas. As hipóteses 4 (endividamento) e 5 (dependência financeira) foram rejeitadas; e 6 (variáveis do perfil do gestor) não foi rejeitada. Mostrando que o perfil do gestor é determinante para o alinhamento das práticas de gerenciamento de riscos na saúde, enquanto as características socioeconômicas de endividamento e dependência financeira apresentam influência significativa inversa.

Palavras-chave: *gerenciamento de riscos, saúde pública municipal, COSO – ERM.*

1 INTRODUCTION

The Brazilian Federal Constitution (Brazil, 1988) states that health is a right for all and a duty of the State. In 1996, the Ministry of Health issued Ordinance No. 1,742, establishing the Basic Operational Norm (NOB) of the Unified Health System (SUS), who worked mainly in management, as a whole, with responsibility for the citizens' health (Andrade, 2001). According to Nunes (2007), this norm is considered an improvement in the management of health services, reinforcing constitutional principles by establishing the municipality as initially responsible for the health situation of its population.

Risk management in public health optimizes resources, reduces waste, and prevents adverse events, improving service efficiency. Preventive policies enable more accurate planning, leading to better care, shorter waiting lines, and higher user satisfaction. Thus, besides reducing costs, they strengthen the sustainability and effectiveness of the healthcare system. In this perspective, in June 2021, according to the federal government platform, the Ministry of Health approved the Risk Management Policy, generating discussions on the importance of risk management.

Among risk management models, the most well-known and widely used globally is COSO II (COSO, 2017). The Committee of Sponsoring Organizations (COSO) has undergone updates since its creation, especially regarding its risk management analysis components, with the latest being the *Committee of Sponsoring Organizations of the Treadway Commission – Enterprise Risk Management Integrating with Strategy and Performance* (COSO, 2017).

The choice of the COSO – ERM 2017 model in this article is due to the fact that, in published academic research, this updated structure is rarely used. As it is a recent tool, understanding its structure and evaluation is necessary before its broader application (Oliveira, 2021). COSO – ERM (2017) comprises five components: Governance and Culture, Strategy and Objective-Setting, Performance, Review and Revision, and Information, Communication, and Reporting.

Several countries use the COSO – ERM (2020) framework and have been implementing improvements to mitigate compliance risks. In the Brazilian context, the Anti-Corruption Law, also known as the Clean Company Law, in force since 2014, provides penalties for certain practices, including bribery, money laundering, and fraud in public procurement contracts, among other offenses.

The issue with Brazil's healthcare system lies not only in the lack of financial and budgetary resources but also in the quality of public spending (SUS, 2022). Rocha (2021) argues that the public health system

is overwhelmed by irrational and inefficient fiscal policies. De Almeida et al. (2021) point out that higher expenditures on healthcare financing do not necessarily translate into better community health conditions. In this context, improving resource management is essential, which includes managerial competence, staff training, commitment, ethics, and effective management tools such as budgeting, control, and risk management.

In light of the concepts found in COSO – ERM and the context of Brazilian public health, this study seeks to address the following research question: What are the determinants of the risk management practices alignment level in Brazilian municipal health management? The main objective of the article is to analyze the determinants of the risk management practices level alignment in Brazilian municipal health management, based on the perception of municipal government managers, using COSO – ERM as a reference.

The risk management practices alignment level determinants within public health management are associated with the profile of managers (experience, education, academic background) and the economic and social characteristics (health, education, governance) of Brazilian municipalities.

A survey was conducted using a questionnaire divided into two parts: the profile of respondents and questions based on the Likert scale regarding risk management practices in the health sector, as outlined by COSO – ERM. It was found that most respondents apply risk management practices in municipal management. After analyzing the questionnaire, which allowed for the identification of the dependent variable in this study, the level of alignment with risk management in public health, hypothesis testing was conducted.

The results indicate that municipal audit offices can strengthen their control mechanisms in public health by improving planning and analysis techniques, contributing to greater effectiveness in risk management in the sector. Additionally, it was inferred from the two samples used that it is essential for Municipal Controllers to have academic training related to administrative management areas, while Health Secretaries require health-related training for better risk management in public health.

This research expanded the managerial accounting literature through the proxy used for the level of alignment in risk management in municipal public health, which served to measure the degree of practices already implemented in municipalities, based on the sample used.

2 THEORETICAL FRAMEWORK

2.1 Risk Management and Support of Research Hypotheses

In 2017, COSO introduced the components of risk management divided into five pillars: governance and culture (governance related to the organization's responsibilities in risk management, and culture linked to ethical values); strategy and objective-setting (related to planning, which outlines risk appetite); performance (prioritizing responses to the most severe risks); review (monitoring the entity's practices over time); and information, communication, and reporting (continuous evaluation of activities). The COSO risk management framework was originally developed by PricewaterhouseCoopers (PwC), a British firm, with the participation of an advisory board of American professionals (Hayne & Free, 2014).

Risk management aims to reduce the costs of uncertain tasks and increase social and economic benefits (Ávila, 2014). In the public sector, most implemented risk management models are international (Oulasvirta & Anttiroiko, 2017; Palermo, 2014).

Specifically in healthcare, the Brazilian National Supplementary Health Agency (ANS) has a Risk Management Manual, whose theoretical foundation is primarily based on COSO, aiming to enhance governance and the effectiveness of entities (ANS, 2018). In this context, control tools aim to assist managerial decision-making, minimizing risks that may be encountered in public health.

However, in general, smaller municipalities do not have a dedicated audit office. These control bodies are useful for providing an overview of management (Bliacheriene et al., 2019). According to Catelli (2012), the role of an audit office is to coordinate the economic management of public entities, improving strategic and operational plans. Thus, it is possible that in smaller municipalities, risk management is either incipient or nonexistent.

In this way, the socioeconomic characteristics of Brazilian municipalities play a crucial role in public health risk management, directly influencing the response capacity and effectiveness of the strategies adopted, which motivated the theoretical hypotheses in this regard, linked to the risk management level implemented (subsection 2.1.1).

Regarding the profile of managers, the lack of adequate training can result in inadequate decisions, compromising the effectiveness of public health policies.

In this sense, the study sought to theoretically relate risk management practices to the technical expertise of public managers, aiming to understand and highlight whether there are connections with their profile (subsection 2.1.2). The interaction between these variables will provide an understanding of the determinants of the level of alignment in risk management practices within Brazilian municipal health management, using COSO – ERM as a reference, based on the perceptions of municipal managers, which is the objective of this investigation.

2.1.1 Hypotheses Related to Socioeconomic Characteristics

The first five hypotheses of the research relate the socioeconomic characteristics of the municipalities comprising the study sample to the risk management alignment level, presenting the scientific support.

Regarding healthcare, risk management has been an important tool in the decision-making, control, and prevention processes for individuals (Freitas, 2002). Additionally, it aims to ensure operational effectiveness and efficiency, as well as to provide a healthcare service with quality and patient safety (Kern et al., 2018).

Economic aspects, as shown by studies conducted in European Union countries, some emerging economies, and municipalities in São Paulo, indicate that the lack of efficiency in the management of public resources in health and education prevents improvements in the quality of these sectors (Afonso et al., 2006; Varela, 2008). Thus, the first hypothesis was formulated:

> **Hypothesis 1 (H_1):** The risk management alignment level with the COSO-ERM model is positively associated with the effectiveness of healthcare spending.

The lack of efficiency in the management of public resources, both in health and education, hinders advancements in the quality of these services, highlighting the importance of high-standard education (Afonso et al., 2006; Varela, 2008).

Schools play a significant role in preparing citizens for social participation and the exercise of citizenship (Figueiredo & Santos, 2013). Thus, the level of education of the population is crucial for social participation (Piortrowski & Van Ryzin, 2007). Additionally, Barros (2016) and Dahlum and Knutsen (2017) complement that education is a mechanism that aligns citizens to act in the public sphere, allowing freedom of expression and opinion, supporting the growth of social participation and political awareness for engagement in public debates. Furthermore, Lindstedt and Naurin (2010) corroborate these statements by emphasizing that the level of education can influence the relationship between citizens and the state, as the higher the level of education, the greater the human capacity to access and process the information disclosed.

In this way, this social demand may be related to a higher level of education, leading to the formulation of the second hypothesis:

> **Hypothesis 2 (H_2):** The risk management alignment level with the COSO-ERM model in Brazilian municipalities is associated with a higher percentage of education among the population.

The importance of risk management systems has grown within organizations, becoming essential for entities to align governance and internal control processes (Ramos, 2015).

For the interrelation of the three pillars of management to occur, an Information Technology (IT) service tailored to the municipal reality is essential. In the absence or limitation of technological tools compatible with the reality of public management, the process of improving public management becomes complicated (Galvão, 2016). Thus, in addition to an adequate Internal Control System, technological tools are of utmost importance to support public service activities (Galvão, 2016). With this, the third hypothesis was formulated:

> **Hypothesis 3 (H_3):** The risk management alignment level with the COSO-ERM model in municipal health management is associated with greater use of quality information technology systems.

When municipalities increase their indebtedness, it affects the lives of the community, as it reduces the resources available for allocation, compromising the public budget (Hamada et al., 2019). Additionally, if there is no control over debts, not only will there be a deterioration of basic services, but it will also jeopardize the country's development (Hamada et al., 2019). This demonstrates the need to invest in management policies, especially given the existing financing challenges in Brazil. Based on these arguments, the fourth hypothesis was formulated:

> **Hypothesis 4 (H_4):** The risk management alignment level with the COSO-ERM model is inversely associated with the level of health debt in the municipality.

De Mello and Matias (2001) argue that financial dependency negatively impacts municipal progress. Complementarily, Oulasvirta and Anttiroiko (2017) state that municipalities without a positive financial situation,

if they do not invest in quality risk management, have much to lose. They also argue that resource scarcity limits investment options.

In this sense, there are concerns about potential effects on the effectiveness of implementing public policies in municipalities with greater financial dependency, as they are more prone to volatility in the volume of available resources (Araújo et al., 2020).

Thus, the fifth hypothesis was formulated.

> **Hypothesis 5 (H_5):** The risk management alignment level with the COSO – ERM risk model in municipal health management is inversely associated with the degree of financial dependence in the municipality.

2.1.2 Hypothesis Related to the Manager's Profile

The research by Araújo (2014) related risk management practices at the Federal University of Paraíba, based on COSO – ERM, using the Likert scale and variables related to the manager's profile, such as the sector of activity, length of experience in the institution, current position, and academic qualifications.

Araújo (2019), through a survey, also used variables related to the manager's profile, such as the position held, length of experience in the institution, and role, in a quantitative approach, analyzing the perception of risk management in Federal Universities, based on COSO – ERM 2017.

The research by Araújo and Gomes (2021) sought to analyze the perception of members of risk committees in Brazilian federal universities regarding the challenges in adopting risk management. Initially, the profiles of the questionnaire respondents were collected (gender, age group, position, education, length of experience in the institution, and in the role). Subsequently, based on the Likert scale, the respondents' perception of the challenges of adopting risk management was assessed. Araújo and Gomes (2021) found that the studied universities have the necessary structure for risk management to be carried out effectively, requiring further structural investments.

The questionnaire applied in this research includes, among other questions, questions that reveal the manager's profile, identifying the period in the position, length of time in the role, the respondent's academic background, and level of education. Thus, the sixth hypothesis was formulated:

> **Hypothesis 6 (H_6):** The risk management alignment level with the COSO – ERM risk model in municipal health management is associated with the profile of the municipal manager.

In the case of hypothesis 6, regarding the academic qualification profile, it is expected that municipal controllers with a background in management (administration, accounting, law) will seek to develop risk management activities with greater skill. The same is expected for health secretaries who have a background related to the health field.

3 METHODOLOGICAL PROCEDURES

3.1 Classification, Survey Population and Respondents

This research is classified as documentary and survey-based, as it collected both primary and secondary data. It is descriptive in nature, as it seeks to understand the characteristics and behaviors of the selected group and sample space. Additionally, it has qualitative and quantitative characteristics, given that it employs relational econometric models aimed at associating variables related to the profile and performance of managers and the adoption of risk management practices.

The survey population consists of Brazilian municipalities, which total 5,568. Since the focus of the study is on the health sector and seeks greater alignment with the topic in question, the research sample comprises the Health Regions of Brazil, totaling 473 Brazilian municipalities.

The respondents of the research are: Municipal Controllers (or those responsible for their duties), given that, in *lato sensu* way, they are responsible for risk management across all areas of governance; and Health Secretaries (or those responsible for their actions), as they are in a *stricto sensu* way responsible for risk management in municipal health policies.

3.2 Variables and Measurement

To analyze the determinants of alignment with the risk management model, variables related to the characteristics of managers and municipalities are used, more specifically, the managers' profile and municipal socioeconomic characteristics. These variables were collected in June 2023.

The choice of the year 2020 for the secondary variables was due to the fact that this work involves aspects related to public health and how municipal administrations manage

their risks. The year 2020 was extremely important for this area, given the complexity brought about by COVID-19.

As the dependent variable, the risk management alignment level in health was considered. This is formed based on the questionnaire questions, which were assigned scores to classify risk management into initial, basic, intermediate, and advanced alignment. Scores were assigned to the questionnaire questions measured by the Likert scale, thereby identifying the level of alignment in health.

3.3 Research Tools

The data collection to measure the level of adoption of risk management practices was conducted through a survey, a structured questionnaire, developed based on the international internal control model, COSO – ERM, with a questionnaire adapted from Oliveira (2021) and Ribeiro (2022).

This questionnaire is divided into two parts: the first part, with six questions, outlines the respondent's profile, and the second part, with one question asking about the respondent's position, and the remaining questions (21 questions) based on the Likert scale, regarding risk management practices in municipal public health.

Regarding socioeconomic characteristics, these were collected through data from the Municipal General Effectiveness Index (IEGM) of the Instituto Rui Barbosa (2022), as well as accounting and budgetary data from the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI).

3.4 Analysis Procedures

The questions about the manager's profile are multiple-choice, except for the questions where the respondent does not find a suitable option and chooses "other", requiring them to specify their answer. As for the second part of the questionnaire, a 5-point Likert scale is used. The level of alignment with risk management in municipal health management and potential determinants of this level were identified.

This questionnaire was developed using Google Forms and initially underwent a pre-test, both in-person and virtual, functioning in a semi-structured, dialogued manner to allow for necessary corrections to the data collection instrument. This was done with individuals connected to public health and municipal management.

Subsequently, the questionnaire was made available virtually from December 19, 2022, to May 19, 2023, totaling 5 months of data collection, and obtaining 145 valid responses, with over 75% (109) being valid. The questionnaires were sent to the Ombudsman's offices of each municipality in the sample, supported by the Brazilian Access to Information Law (LAI), Law No. 12,527, of November 18, 2011.

The statistical tests conducted were Cronbach's Alpha, which measures the correlation between questions, showing the consistency of the results obtained through the questionnaire (Field, 2009); Pearson's correlation; and Tobit regression. The Tobit model was chosen due to the dependent variable, which is the risk management alignment level.

To determine the dependent variable, based on the applied questionnaire, which corresponds to the level of alignment of risk management practices in municipal health management, scores were assigned to the agreements and disagreements with the statements in the questionnaire, following Ribeiro (2022), to align with the framework proposed by COSO 2017: a) Strongly disagree – 1 point; b) Partially disagree – 2 points; c) Neutral – 3 points; d) Partially agree – 4 points; and e) Strongly agree – 5 points.

Table 1 presents the variables used in this study, showing their operationalization and the basis through scientific research and data collection portals. The table is divided into Panel A, the dependent variable, and Panel B, the independent variables.

To analyze data reliability, Cronbach's Alpha was used, as shown in model 1, obtained through the following equation (Oliveira, 2021):

$$\alpha = \left(\frac{k}{k-1}\right)\left(1-\frac{\sum_{i=1}^{K} Si^2}{St^2}\right) \quad (1)$$

where k = number of items in the questionnaire; Si^2 = variance of each item; St^2 = total variance of the questionnaire.

The α coefficient varies between 0 and 1, where 1 refers to 100% consistency of the questionnaire and 0 is the total absence. According to Martins and Teophilo (2009), a good indicator of consistency is values greater than 0.7.

To test the variables, model 2 was initially used:

$$GR_{it} = \beta_1 IEGMsau_{it} + \beta_2 IEGMedu_{it} + \beta_3 IEGMti_{it} + \beta_4 Endiv_{it} + \beta_5 DepFinanc_{it} + \beta_6 EfetCom_{it} + \beta_7 AtuCarg_{it} + \beta_8 Fun_{it} + \beta_9 Formacad_{it} + \beta_{10} Escol_{it} + \varepsilon \quad (2)$$

For model 2, Tobit was used. Modifications were made to the model to better adapt it to test the research hypotheses. All changes are presented in the results analysis topic.

Table 1
Explanatory table of the research dependent and independent variables

Panel A – Dependent Variable			
Variable name	**Variables Operationalization**		**Source**
	Index and Alignment Level	**Description**	
Risk Management (RM) Level	0 – 25 = Initial	Low level of formalization; documentation on risk management not available; lack of communication on risks.	Ribeiro (2022); Vieira and Barreto (2019); Oliveira (2021).
	25.01 – 50 = Basic	Risk management handled informally; there is still no training and communication about risks.	
	50.01 – 75 = Intermediate	There are documented principles and standards, and basic training on risk management.	
	75.01 – 100 = Advanced	Optimized risk management; risk management principles and processes are integrated into the organization's management processes.	
Panel B - Independent Variables			
General Effectiveness Index of the Municipality, specific to health (IEGMsau)	The methodology used for the variables of the Municipal Management Effectiveness Index – IEGM, a standard indicator of the National Network of Public Indicators – Rede Indicon, was conceived in 2015 by the São Paulo State Court of Accounts and made available to the Courts of Accounts by the Rui Barbosa Institute – IRB. The objective of the IEGM is to collect data that can be used as a reference to support external control activities, improve governmental performance, provide relevant information to citizens about local public administration, and generate analyses aimed at the development of public policies.		Kern et al. (2018); Afonso et al. (2006); Varela (2008); Motoki et al. (2021).
General Effectiveness Index of the Municipality, specific to education (IEGMedu)			Figueiredo and Santos (2013); Piortrowski and Van Ryzin (2007); Barros (2016); Dahlum e Knutsen (2017); Motoki et al. (2021); Lindstedt and Naurin (2010).
General Effectiveness Index of the Municipality, specific to information technology governance (IEGMti)			Ramos (2015); Galvão (2016).
Indebtedness (Endiv)	Result of the ratio between debts and revenues, specific to health.		Lima e Diniz (2016); Hamada*et al.*(2019); Motoki et al.(2021).
Financial Dependency (DepFinanc)	Ratio of current transfers minus indirectly collected taxes to total operating revenue.		Lima e Diniz (2016); De Mello e Matias (2001); Oulasvirta and Anttiroiko (2017); Araújo et al. (2020); STN.
Effective or Commissioned (EfetCom)	Dummy, with a value of 1 if the server is effective; and 0, when it is commissioned, both for municipal controller and health secretary.		Araújo (2014); Araújo (2019); Araújo and Gomes (2021); Questionnaire.
Time spent in the position (AtuCarg)	It is the time spent in the position, whether permanent or commissioned, as a controller or health secretary, an independent variable. This variable was obtained from the responses to the questionnaire, in which the longest time in years of the response was stated, being 16 for the option with more than 15 years.		
Length of time in the role (Fun)	Represents the time spent in the role, where: the value 0 was assigned if the respondent had never performed the role before, 4 if he/she performed it for up to 4 years, and 5 if he/she performed it for more than 4 years.		
Academic background (Formacad)	Represents the academic background of the respondent, an independent variable. It is a dummy variable, with the value 1 being assigned to municipal controllers if the respondent has courses related to management, such as accounting, law and administration, and 0 for other degrees. In the case of health secretaries, it is also a dummy variable, with the value 1 being assigned to those with degrees in the health area, and 0 for other degrees.		
Level of education (Escol)	This is the level of education of the questionnaire respondents, an independent variable. It is a scaled variable, with 0 being the value assigned to those who did not have a higher education level, 1 to those who had a higher education level, 2 to those who have a specialization, 3 for a master's degree, and 4 for a doctorate.		

Source: *Prepared by the authors.*

4 RESULTS ANALYSIS

4.1 Reliability Analysis

Cronbach's Alpha was calculated based on the 21 questions in the questionnaire, proving to be high (Martins & Teophilo, 2009), with a percentage of 92.33%, demonstrating the reliability of the data collection instrument.

4.2 Profile of Controllers and Health Secretaries of Brazilian Municipalities

Table 2 presents the responses to the questionnaires on the profile of municipal controllers and health secretaries. Of the total responses accepted, 109 questionnaires, 54.13% (59 respondents) refer to the position of Municipal Controller, and 45.87% (50 respondents) to Health Secretaries.

It is noted that the majority of respondents are not permanent employees, accounting for 47.63%; and among the civil servants who hold permanent positions, 24.8% have been in their roles for over 15 years. Although the remaining 75.2% have been in their positions for a shorter period, the fact that nearly 25% of the civil servants have been in their roles for more than 15 years reflects their likely satisfactory experience in municipal management, providing relevant services to society and contributing to risk management, which is the focus of this research.

Regarding civil servants in appointed positions, the majority (37.7%) have been in their roles for up to 2 years. This may be motivated by the fact that these positions are generally political appointments, and since elections occur periodically every 4 years, the mayor's interest may change over time.

The question content, whether the respondent had previously held the position, either in the current municipality or another, is crucial for this research. It could be inferred that if the majority of respondents had previously held the position, they might have greater expertise in risk management. However, 66.06% had never held the position before.

Regarding academic background, respondents were asked to consider the highest level of education completed. In terms of percentages, it was observed that accounting and law degrees predominated, totaling 24.32%. As for the level of academic education, a significant portion holds a specialization (60.55%).

Table 2
Respondent profile

Number of years in effective position	Number of responses	Percentage	Number of years in a commissioned position	Number of responses	Percentage
I am not a permanent employee	52	47.63	0 to 2 years	23	37.7
0 to 2 years	1	0.92	2 to 5 years	19	31.15
2 to 5 years	7	6.44	5 to 10 years	14	22.95
5 to 10 years	8	7.36	10 to 15 years	4	6.56
10 to 15 years	14	12.85	More than 15 years	1	1.64
More than 15 years	27	24.80			
TOTAL	109	100	**TOTAL**	61	100
Previously held the position in the current municipality or in another	**Number of responses**	**Percentage**	**Academic background**	**Number of responses**	**Percentage**
Yes, for up to 01 year	6	5.6			
Yes, for up to 04 years	12	11			
Yes, for more than 04 years	19	17.43	Accounting	27	24.32
I have not previously held this position	72	66.06	Law	27	24.32
TOTAL	109	100	Business Administration	12	10.81
Level of academic education	**Number of responses**	**Percentage**	Economics	2	1.80
			Medicine	2	1.80
Secondary level	2	1.83	Nursing	19	17.12
Incomplete higher education	2	1.83	Nutrition	1	0.9
Complete higher education	23	21.1	Physiotherapy	3	2.7
From 5 to 10 years	8	7.36	Others	18	16.23
From 10 to 15 years	14	12.85	10 to 15 years	4	6.56
More than 15 years	27	24.80	Over 15 years	1	1.64
TOTAL	109	100	**TOTAL**	61	100

Source: *Prepared by the authors.*

4.3 Sector/Unit Responsible for Risk Management

Beginning the inferences about the characteristics of the municipalities in the health regions, it has been identified that nearly 70% stated they have a responsible agency for risk management, with the two most cited sectors being the Controller's Office at 27.52% (30 responses) and the Health Secretariat at 22.9% (25 responses). This shows that in the majority of municipalities, there is some form of adoption of risk management actions.

4.4 Descriptive Statistics Results

In the second part of the questionnaire, each question about the COSO-ERM model is specified as shown in Table 3.

Table 3
Correspondence of each statement by COSO Component

Statements	COSO Component
The Municipality has a risk management model specifically aimed at public health.	Culture and Governance
In the Comptroller's Office/Health Secretariat, Human Resources practices encourage improvement and development in health risk management, through training and qualifications.	
Good risk management practices are shared regularly within the institution.	
In your view, there is broad dissemination and sharing among employees of the strategic objectives established for the Institution.	Strategy and goal setting
The objectives are aligned with the risk levels, that is, within the defined risk appetite (acceptable risk level) and the acceptable variations in public health performance.	
It is the institution's practice to hold meetings to identify and manage risks that could compromise the objectives achievement.	
Measurements associated with institutional performance are used to manage risks associated with public health established for the Institution.	Performance
The Municipality considers event identification techniques, examining both previous occurrences and potential future events to identify risks, such as the use of process mapping, risk matrix and scenario analysis.	
There is a score (probability of event occurrence x impact of event) for health risks in the Municipality.	
Existe a identificação e tratamento dos riscos identificados. Quais sejam, evitando, aceitando, compartilhando ou reduzindo estes riscos.	
There is monitoring of medications (validity, storage, identification by patient...).	
There is nutritional monitoring of patients.	
There is monitoring of supply stock (masks, syringes, alcohol...).	
There is preparation for epidemics in the Municipality.	
The responsible sectors are usually alert to the occurrence of important events (outbreaks, lack of supplies, bed congestion) in other regions.	
Risk management is encouraged by senior management and recognized with some type of incentive/reward.	
There are mechanisms for continuous assessment of the quality of the risk management system.	Review
There is a communication protocol so that deficiencies found in the monitoring of municipal health risks are communicated to the Health Department/Comptroller's Office.	
It is the practice of the Health Department/Comptroller's Office administration to hold meetings in order to obtain feedback on the effectiveness of risk management in public health.	
Communication of the importance and relevance of effective risk management is transmitted by senior management to other managers of the Institution and to public health servants.	Information, Communication and Reporting
There is a public service channel for reporting observable public health risks.	
There is a way of officially disclosing indicators of risks to municipal public health.	

Source: *Adapted from Ribeiro (2022) and Oliveira (2021).*

The data collected from these questions described in Table 3 were used to perform a descriptive analysis of the sample of this research, according to model 2 described in the methodology, using the Tobit econometric model. Table 4 shows the calculations of the mean, standard deviation, minimum and maximum in decimals, ranging from 0.00 to 1.00, for each variable:

Table 4
Descriptive statistics for the sample of municipal controllers and health secretaries

Variables	Municipal Controllers (Obs.: 29)				Health Secretaries (Obs.: 21)			
	Average	Standard deviation	Minimum	Maximum	Average	Standard deviation	Minimum	Maximum
RM	0.67	0.18	0.31	1.00	0.80	0.15	0.40	0.98
IEGMsau	0.63	0.14	0.23	0.88	0.70	0.10	0.53	0.88
IEGMedu	0.50	0.15	0.23	0.77	0.54	0.15	0.27	0.84
IEGMti	0.65	0.16	0.12	0.90	0.59	0.18	0.33	0.92
Endiv	0.01	0.01	0.00	0.05	0.00	0.00	9.37e-06	0.01
DepFinanc	0.41	0.11	0.19	0.63	0.40	0.10	0.23	0.60
EfetCom	0.37	0.49	0.00	1.00	0.28	0.46	0.00	1.00
AtuCarg	8.10	5.43	2.00	16.00	6.95	5.12	2.00	16.00
Fun	1.31	2.10	0.00	5.00	2.28	2.30	0.00	5.00
Formacad	0.89	0.30	0.00	1.00	0.61	0.49	0.00	1.00
Escol	1.93	0.79	0.00	3.00	2.04	0.66	1.00	3.00

Source: *Prepared by the authors.*

The RM in the sample of health secretaries had an average of 0.8, a value higher than that of controllers, which was 0.67. This shows that municipalities are already taking steps in risk management practices in public health. It should be noted that the analyzed data does not extend beyond the scenario presented here.

Regarding the effectiveness indices in health, education, and governance and information technology, they also showed averages above 50%, indicating a relevant relationship between RM and IEGM.

The indebtedness variable has a low value, indicating that the municipalities in the sample do not show a high level of indebtedness. In the case of financial dependency, the average is relatively high. This can be explained by the heterogeneity of the municipalities in the sample, where the population size varies significantly when compared among them, as, in general, only capitals and municipalities with characteristics similar to capitals have sufficient own revenue capacity to cover their activities.

Regarding the profile of managers, the EfetCom variable shows that the majority of the research sample are appointed positions. This average can be explained by the permanent positions, where most of the permanent respondents have been in their positions for at least 10 years.

About the question of whether the controller or municipal health secretary has held the position before, it is observed, looking at the Fun variable, that the majority of respondents have never held the position before.

For academic background, the average of approximately 90% shows that municipal controllers have more responses related to management education, mainly in law and accounting. Regarding the sample of health secretaries, the average obtained was 0.62, showing that the majority have a background in health. The most common level of education (Escol) is specialization.

4.5 Hypothesis Testing for the Sample

Model 3 served to test the first three hypotheses, which relate the characteristics of municipalities with effectiveness in health, education, and governance in information technology with the level of risk management in public health.

$$GR_{it} = \beta_1 IEGMsau_{it} + \beta_2 IEGMedu_{it} + \beta_3 IEGMti_{it} + \varepsilon \quad \boxed{3}$$

The following results of the regression of the empirical model were observed, according to Table 5:

Table 5
Coefficients and statistics obtained from regression model 3

	RM	Coefficient	Standard deviation	*t*	*p-value*	95% Confidence	Interval
Municipal Controllers	IEGMsau	0.15	0.29	0.52	0.60	-0.41	0.72
	IEGMedu	0.59	0.31	1.90	0.05	-0.01	1.21
	IEGMti	0.39	0.23	1.71	0.08	-0.05	0.84
Health Secretaries	IEGMsau	1.19	0.16	7.41	0.00	0.87	1.50
	IEGMedu	-0.17	0.26	-0.64	0.52	-0.70	0.35
	IEGMti	0.08	0.21	0.38	0.70	-0.34	0.51

Source: *Prepared by the authors.*

For the sample of Municipal Controllers, all independent variables showed a positive coefficient with RM, with the greatest influence being from IEGMedu (Education Effectiveness Index), given that its coefficient value is higher compared to the other effectiveness indices. When observing the *p-value*, IEGMedu shows significance at the 5% level and IEGMit (Governance and Information Technology Effectiveness Index) at the 10% level. This means that as effectiveness in education and governance and information technology increases, the better the risk management practices in municipal public health will be. Thus, the level of risk management is reflected in IEGMedu and IEGMit.

In the case of Health Secretaries, a statistically significant positive relationship with RM was observed only for IEGMsau (Health Effectiveness Index) at the 1% level, showing that the better the effectiveness of health services, the better the risk management practices will be.

The results were different for the first three hypotheses of the research, depending on the samples. Hypothesis H_1, which uses IEGMsau as a *proxy*, predicts that the level of alignment of risk management with the COSO – ERM model is positively associated with the effectiveness of health expenditures. According to the results presented in Table 5, H_1 should be rejected for the sample of municipal controllers, but not for health secretaries.

It can be inferred that, since health secretaries have undergraduate degrees in specific areas, along with operational experience in health management, and likely specialization in aspects related to auditing and public health risks, this group has a high level of knowledge in risk management, positively impacting the quality of health services. This corroborates the studies by Kern et al. (2018), who state that risk management aims to ensure operational effectiveness and provide a health service that prioritizes quality and patient safety.

Hypotheses H_2 and H_3 should be rejected for the sample of health secretaries, which is not the case for municipal controllers. These hypotheses, H_2 and H_3, refer respectively to effectiveness in education and governance and information technology. It is presumed that municipal controllers, due to most of them having a background in administrative/financial management, have greater experience and technical skills to manage education and governance in information technology.

For H_2, there is congruence with the findings of Figueiredo and Santos (2013), who highlight the relationship between schools and higher levels of social participation; with Piortrowski and Van Ryzin (2007), who argue that higher levels of education translate into greater social participation; and with the studies of Barros (2016); Dahlum and Knutsen (2017), who treat education as a mechanism for increasing social participation and political awareness, as well as the arguments in Lindstedt and Naurin (2010); COSO (2020), which emphasize that the level of education can influence the better processing of disclosed information.

Hypothesis 3 demonstrates conformity with the findings of Galvão (2016), who shows that a lack or limitation of technological tools compatible with the reality of public management can hinder improvements.

To test hypothesis H_4, Model 4 was used, which negatively relates the level of risk management to indebtedness:

$$GR_{it} = \beta_1 Endiv_{it} + \varepsilon \quad \boxed{4}$$

Table 6 shows the regression results for testing hypothesis 4:

Table 6
Coefficients and statistics obtained from regression model 4

	RM	Coefficient	Standard deviation	*t*	*p-value*	95% Confidence	Interval
Municipal Controllers	Endiv	22.12	6.52	3.39	0.00	9.33	34.91
Health Secretaries		105.83	16.48	6.42	0.00	73.51	138.15

Source: *Prepared by the authors.*

The relationship between indebtedness and the level of risk management shows a positive coefficient, which was not expected based on the hypothesis. The *p-value* was statistically significant at the 1% level, indicating that the higher the indebtedness in public health, the better the risk management practices will be. One possible explanation is that the higher the indebtedness, which stems from possible voluntary transfers, the greater the attention and requirements imposed by the grantors.

Therefore, hypothesis H_4 should be rejected, contradicting the study by Hamada et al. (2019), who explain that when municipalities increase their indebtedness, it affects the lives of the community because there is a reduction in resources available for allocation.

Hypothesis H_5 was tested using empirical model 5, as follows:

$$GR_{it} = \beta_1 DepFinanc_{it} + \varepsilon \quad \boxed{5}$$

According to Table 7, the following regression results were obtained:

Table 7
Coefficients and statistics obtained from model 5

	RM	Coefficient	Standard deviation	*t*	*p-value*	95% Confidence	Interval
Municipal Controllers	DepFinanc	1.53	0.10	14.47	0.00	1.32	1.74
Health Secretaries		1.84	0.13	13.60	0.00	1.58	2.11

Source: *Prepared by the authors.*

Despite the statistical significance, this hypothesis should also be rejected, as a negative association between DepFinanc and RM was expected. In other words, it was presumed that the higher the financial dependency, the weaker the risk management practices in municipal public health would be. This contradicts the studies of Oulasvirta and Anttiroiko (2017), as well as Araújo et al. (2020), who argue that financial dependency, due to fluctuations in available resources, can compromise the implementation of public policies. Thus, an association with risk management can be inferred.

Another explanation for this finding could be that investments in risk management were not of high quality or that resource scarcity limited investment options. It is possible that a higher financial dependency of municipalities leads to a greater need for voluntary transfers, which, in turn, may result in stricter requirements from the granting entities.

Regarding hypothesis H_6, a test was conducted for the characteristics of the municipal manager's profile. For this, empirical model 6 was run:

Table 8 expresses the regression results of model 6:

$$GR_{it} = \beta_1 EfetCom_{it} + \beta_2 AtuCarg_{it} + \beta_3 Fun_{it} + \beta_4 Formacad_{it} + \beta_5 Escol_{it} + \varepsilon \quad \boxed{6}$$

As observed in Table 8, the variables used as characteristics of the manager's profile showed differences in significance with the level of alignment of risk management in public health, depending on the sample, whether it was a secretary or municipal controller.

Table 8
Coefficients and statistics obtained from model 6

	RM	Coefficient	Standard deviation	*t*	*p-value*	95% Confidence	Interval
Municipal Controllers	EfetCom	-0.27	0.18	-1.51	0.13	-0.62	0.08
	AtuCarg	0.02	0.01	1.75	0.08	-0.00	0.05
	Fun	0.00	0.02	0.24	0.80	-0.04	0.05
	Formacad	0.42	0.15	2.67	0.00	0.11	0.73
	Escol	0.06	0.07	0.85	0.39	-0.08	0.20
Health Secretaries	EfetCom	-0.37	0.14	-2.60	0.00	-0.66	-0.09
	AtuCarg	0.01	0.01	1.26	0.20	-0.00	0.04
	Fun	0.02	0.02	0.98	0.32	-0.02	0.07
	Formacad	0.04	0.12	0.33	0.73	-0.20	0.29
	Escol	0.31	0.06	5.26	0.00	0.20	0.43

Source: *Prepared by the authors.*

Regarding the municipal controller, RM showed statistical significance with the variables AtuCarg and Formacad. Therefore, the longer the time in the position, the better the dedication of municipal controllers to risk management actions. Similarly, the higher the academic background of the controller, the better the risk management practices will be.

For the sample of municipal public health secretaries, RM was significant with the variables EfetCom and Escol. The variable representing whether the health secretary holds a permanent or appointed position, despite its significance with RM, has a negative coefficient. This may have occurred due to the short time in the position (AtuCarg), a variable that did not show statistical significance. As for the education level, it is noted that the higher this level, the better the risk management practices in public health will be.

Thus, hypothesis 6 should not be rejected, as the manager's profile, regarding time in the position, academic background, whether the position is permanent or appointed, and education level, were significant for risk management. This does not generalize the statements, but the significance of these manager profile variables means that H6 should not be rejected, particularly concerning the variables of academic background and time of experience in the position (Araújo, 2014; Araújo, 2019).

Most importantly, this corroborates the research by Araújo and Gomes (2021), which specifically analyzed the perception of members of risk committees in Brazilian federal universities regarding the challenges in adopting risk management.

4.6 Discussion of Results

Table 9 presents a summary of the relationship between the independent variables and the level of risk management in Brazilian municipal public health, tested by the six hypotheses.

As can be observed, hypotheses H_1, H_2, and H_3, which relate to socioeconomic characteristics, were not rejected, indicating a direct relationship between the level of risk management in public health and the capacity for planning, execution, and monitoring of actions in the public sector. However, hypotheses H_4 and H_5 were rejected, showing that although municipalities with low revenue and high dependency on intergovernmental transfers face budgetary limitations, often prioritizing emergency demands over long-term planned actions, the variables of indebtedness and financial dependency do not demonstrate a significant relationship with risk management in municipal public health.

Hypothesis H_6, which analyzes variables related to the manager's profile, was not rejected as it showed statistical significance with the level of alignment of risk management in municipal health, particularly regarding time in the position, academic background, whether the position is permanent or appointed, and education level. Managers with adequate technical training and experience in public administration tend to implement more assertive strategies to identify, assess, and mitigate risks. The capacity for critical analysis and knowledge of public policies are factors that enhance the quality of decisions and the execution of risk management actions, even in contexts of financial or structural limitations.

The efficiency of risk management in public health depends on the integration of health, education, and information technology. Although indebtedness and financial dependency were not statistically significant, managers should consider them to enable investments. The profile of controllers and health secretaries influences the optimization of these practices, making continuous training, academic partnerships, and periodic evaluations essential to strengthen risk management.

Table 9
Summary of the relationship of hypotheses found according to the sample

Aspects Analyzed	Independent Variable	Relationship found	
		Municipal Controller	Secretary of Health
Socioeconomic Characteristics	IEGMsau	H_1 rejected	H_1 was not rejected
	IEGMedu	H_2 was not rejected	H_2 rejected
	IEGMti	H_3 was not rejected	H_3 rejected
	Endiv	H_4 rejected	H_4 rejected
	DepFinanc	H_5 rejected	H_5 rejected
Manager Profile	EfetCom	H_6 was not rejected	H_6 was not rejected
	AtuCarg		
	Fun		
	Formacad		
	Escol		

Source: *Prepared by the authors.*

5 FINAL CONSIDERATIONS

This study examined the factors influencing the alignment of risk management practices in municipal health, based on COSO – ERM. The results show that although municipalities already adopt these strategies, there are still challenges to overcome. The maturity level of these practices is influenced by the socioeconomic conditions of the municipalities and the profile of the managers. The analyses revealed similarities and differences between municipal controllers and health secretaries. Despite this, risk management was positively associated with municipal governance in health, education, and information technology. Additionally, the education level, academic background, and experience of managers directly impact the effectiveness of these practices.

From a theoretical perspective, this study contributes to the literature on public management accounting by developing a *proxy* to measure the alignment of risk management practices in municipal health, enabling the assessment of their degree of adoption. Practically, it highlights the importance of continuous training for managers, demonstrating the impact of academic background and experience on effective risk management. Furthermore, it provides relevant insights for public administration professionals, reinforcing the need for ongoing education and specialization to improve decision-making and the implementation of more effective policies.

Methodologically, the research contributes by using primary data based on the perceptions of managers, allowing an internal view of the municipal reality. However, there are challenges in applying these variables in different contexts. The availability and quality of data vary between municipalities, affecting the reliability of the analyses. Additionally, the heterogeneity of scenarios makes it difficult to generalize the findings, as socioeconomic, environmental, and structural factors influence each locality differently. The choice of statistical models and the interaction between variables also present challenges, potentially introducing biases or excessive simplifications. Thus, this represents a limitation for this study.

Future research should explore new variables, analysis periods, and complementary methodologies, such as interviews and case studies, to deepen the understanding of risk management in municipal public health. Moreover, comparative investigations between states or countries and the use of longitudinal analyses and predictive modeling can enhance the strategies adopted, making them more effective and adaptable to the needs of municipal administrations.

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