ENHANCING DATA SECURITY PROTOCOLS: AN ANALYSIS OF FUNDED SOCIAL SERVICE AGENCIES IN SINGAPORE

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Dedication

This dissertation is dedicated to my parents, my late father, Mohd Yacob Bin Ibrahim, and my late mother, Salbiah Binte Semat, whose unwavering belief in the power of knowledge and education inspired me to pursue my doctoral degree. Their values of integrity, perseverance and lifelong learning have been the guiding principles throughout

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ABSTRACT

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Cybersecurity is a critical concern for funded social service agencies in Singapore, given their responsibility to protect sensitive data while complying with regulatory requirements. This study examines how these agencies implement cybersecurity measures, manage threats, and adhere to regulations under the Personal Data Protection Act (PDPA) and the Cyber Security Act (CSA). The research also evaluates the effectiveness of incident response strategies, employee training programs, and inter-agency collaboration in enhancing cybersecurity resilience.

A quantitative research approach was employed, collecting survey data from agency representatives. Statistical analyses, including ANOVA, Pearson correlation, Chi-Square, and regression tests, were conducted to identify variations in cybersecurity preparedness across different agency types. The findings indicate that while most agencies have formal security policies, their implementation is challenged by financial constraints, limited expertise, and regulatory complexities. Larger, well-funded agencies are better equipped to manage cybersecurity risks, while smaller and non-profit agencies struggle with maintaining up-to-date security frameworks.

Incident response strategies were found to vary significantly among agencies, with structured plans more common in well-resourced organisations. Employee training emerged as a key factor in reducing security breaches caused by human error, reinforcing the need for continuous education programs. The study also highlights the role of collaboration in strengthening cybersecurity, though concerns about data sensitivity and compliance requirements often limit inter-agency cooperation.

The study recommends targeted interventions to enhance cybersecurity resilience in the sector. These include simplifying compliance frameworks, increasing funding support, adopting AI-driven security solutions, and developing structured training programs to mitigate human error. Strengthening partnerships between social service agencies, government bodies, and cybersecurity professionals can facilitate knowledge-sharing and resource optimization.

The research contributes to policy discussions on improving cybersecurity measures within the social service sector and underscores the importance of balancing compliance with practical security implementations. Future research should explore emerging cybersecurity threats, long-term impacts of compliance policies, and the effectiveness of evolving security technologies in protecting social service organisations.

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CHAPTER I:
INTRODUCTION

1.1 Introduction

With the rise of a digital world, it is now the most important issue to ensure the security of sensitive data especially by those organisations who deal with lots of personal and financial information. The social service agencies focusing on vulnerable groups are the most vulnerable to security risks with digital records as the main means of case management, funding distribution, and service delivery. In Singapore, there are strict data protection laws which the funded social service agencies have to adhere to, among which is the Personal Data Protection Act (PDPA) and other government-imposed cybersecurity measures (Niphadkar, 2016). Nonetheless, security breaches and security threats in the recent past show that current security is inadequate to guard against emerging threats despite the above regulations.

The current dissertation seeks to evaluate and improve data security measures at funded social service organisation in Singapore by defining the breach areas, determining the security protection mechanisms, and suggesting better safeguarding framework that will protect the sensitive information. The researcher would focus on examining how far the agencies adhere to the current security guidelines, the issues they encounter in establishing effective data protection policy and on the part of technology in enhancing the cybersecurity capabilities of the agencies and especially [specific technology]. This form of technology is selected due to its [specific benefits], which makes it a viable and cost-efficient solution.

Considering the growing trend of digitalization of services, as well as the augmented threat of cyber-attacks, including phishing, data leakage, and access by unauthorized parties, the security of digital information can no longer be regarded as optional but one of the essential tasks. Social service agencies deal with very sensitive information such as that of the beneficiaries, the amounts of money they receive, as well as the histories of their courses and thus become the most desirable objectives of cybercriminals. Also, these agencies find it hard due to resource limitations, expertise in cybersecurity capability and limited budget to embrace advanced security solutions. Hence, it is important to review their data security environment in order to build sustainable and economically viable practices to protect data.

The study will add value to the current debate regarding data security by presenting empirical evidence on the efficacy of present security interventions in the social service agencies and giving practical suggestions of what should be done in that respect. Conciliating the regulatory demands and the practical challenges of implementation, the study is aimed at helping policymakers, funding agencies, and agency leaders enhance the resilience of the social service agencies to cybersecurity threats.

1.2 Importance of Data Security in Social Service Agencies

Practices involving data security are influential factors that affect efficiency of operations and service delivery within social service agencies operating in Singapore. Adherence to Singapore Personal Data Protection Act (PDPA) results in administrative challenges, as well as strengthens trust and accountability in agencies. The benefits of integrating safe ICT solution include enhanced efficiency in the operations, financial accountability, as well as delivery of services due to efficient data management, and minimization of redundancy. Nonetheless, multi-agency cooperation can be limited due to the necessity of strict data security policies which limit access to vital information. In terms of servicing, a secure approach will improve community confidence and make people more inclined towards using digital social services. Additionally, crisis continuity is guaranteed by secure digital systems that must allow remote access to critical services in case of a crisis like a pandemic. Although these benefit this implementation, this implementation may be disadvantaged by strict security measures such as encryption and limited access which might take longer to respond to any queries thus depriving the frontline workers of enough time to access information.

There are several issues that funded social service agencies encounter regarding the establishment and preservation of strong data security practices. The burden of adherence to data protection legislation, which a country like Singapore has articulated in its Personal Data Protection Act (PDPA), is a single critical involvement since it takes a great deal of administration and resources to see that this body of legislation is followed. Inadequate funding and resource constraints further add to the problem where most of the agencies cannot afford to spend funds on advanced cybersecurity infrastructure, training of the staff, and other relevant maintenance.

The other main concern is to work the data security measures into the legacy systems currently in place. Social service agencies have an old IT infrastructure and imposing new security solutions will be hard since the major work will be affected. Furthermore, the issue of in-house cybersecurity expertise is also a major risk because social service agencies might lack the required expertise required to overcome the potential threat of data security.

Security risks such as data breach and online threats affect compliance and trust of social service agencies to regulatory frameworks to a great extent. Among the main effects, the loss of trust among people can be noted. In case of data breach it is not uncommon that the respective individuals lose their trust in the safety of their sensitive data held by the agency and that their interaction with digital services will be reduced and they are unwilling to provide their personal data. Also, the breaches cause legal and regulatory consequences, since the data protection acts mandate the agencies to abide by strict data protection regulations, including the Singapore Personal Data Protection Act (PDPA). Improper maintenance may result in fines, lawsuits and further regulatory assessments in case a breach should occur.

Furthermore, breaches expose agencies to operational disruptions. The immediate response to a cybersecurity incident—investigating the breach, notifying affected individuals, and implementing corrective measures—diverts resources away from service delivery and increases financial burdens. Moreover, agencies often face difficulties regaining compliance after a breach, as they must adopt stricter security measures, improve risk management processes, and demonstrate enhanced governance practices to regulatory bodies.

1.3 Definitions of Key Terms

In order to keep this study clear and unified, the chief terms of this research are as follows and presented in relation to data security in funded social service agencies:

Data Security: Preventing access, corruption or theft of digital information by an unauthorized user. It encompasses encryption, controls as well as cybersecurity structures to protect sensitive information.

Social Service Agencies: Offer necessities services such as welfare, health, education and help provisions to the vulnerable groups. This research will be based on the funded social service organisations in Singapore who work under government or institutional funding.

Funded Social Service Agencies: These are non-profit or community-based organisations which depend on government grants or institution grants or charity donations to provide services to the population. Protection of data applies in these agencies as they deal with sensitive information of the beneficiaries.

Personal Data Protection Act (PDPA): The data privacy and security legislation in the Republic of Singapore that provides rules in collecting, using, and disclosing personal data. It lays down responsibilities on organisational entities (viz includes social service agencies) and their responsibility to protect personal information and to comply with principles of data protection.

Cybersecurity Threats: Threats that have the potential of compromising data confidentiality, integrity and data availability within digitally based systems. These are phishing, ransomware, data breaches, malware, and insiders.

Data Breach: A situation where confidential data falls into the wrong hands and might cause leakage of the information, identity theft, or even violation of regulatory requirements. It may happen when it is hacked, when it is weakened, or when it is done by a human being.

Regulatory Compliance: Refers to the practice of ensuring legal and industry-specific standards of data protection, which include PDPA, ISO 27001, etc., are followed by the organisations.

Risk Management: A structured process of determining, evaluating and reducing the risk of data security that could endanger the digital infrastructure and operations of an organisation. The risk management should cover incident response planning, threat detection, and security audit.

Data Encryption: Data encryption is a form of cybersecurity that uses commands to code data to prevent unwary access or amendment. This is because sensitive data will be encrypted hence protecting them in case they are intercepted by cybercriminals.

Access Control: A form of security that limits individuals, roles or privileges who can access or change digital data. Access controls are introduced to ensure that confidential data will not be accessed by the unauthorized workers in the social service agencies.

Cloud Security: A group of cybersecurity measures taken to defend information, applications as well as systems in the cloud. Since more social service agencies are moving to the cloud-based platform, it is crucial that such data storage and communications are safe.

1.4 Research Problem

Nowadays, in the era of information technology, data protection is one of the key issues of organisations that manipulate information with sensitive data such as social service agencies that deal with vulnerable populations personal, financial, and health-related information. In Singapore, the commissioned social service agencies should follow the governing structures including Personal Data Protection Act (PDPA) and other government-imposed cybersecurity regulations. Regardless of these regulations, however, data breach, unauthorized access, and compliance are still some critical risks, which could negatively impact trust and performance among citizens and the quality-of-service delivery.

The growing technicality of cybercrimes coupled with technical incompetence and limited budgetary provisions of most social service agencies forms a problematic environment which at best poses a challenge in protecting data. Most agencies have not been able to apply strong security standards, thus exposing them to cyber-attacks, inadvertent release of information, and non-compliance. Moreover, the challenge of maintaining a high operational efficiency and at the same time achieving high regulatory standards frequently leads to loopholes in security control and management.

Literature on data security in the business and finance world has been widely considered, mostly at the expense of non-profit organisations and social services organisations. This shortage in empirical research concerning how the existing security controls are performing in social service agencies makes it difficult to come up with custom solutions that can be used to increase compliance and reduce security risks.

Consequently, this research will aim at examining the current forms of data security, its weaknesses, and offer a solution to enhance the safeguarding of information in funded social service agencies in Singapore. The study will address this issue of research gap, which will guide the policymakers, funding organisations, and agency heads to take some actionable steps to safeguard data security habits, comply with protocols, and protect sensitive data.

1.5 Purpose of Research

Data security protocols implemented in funded social service agencies in Singapore will be assessed, analysed, and improved in this research. Amidst the emergent risks of data breaches, cyber threats, and regulatory compliance issues, the current study will help find out the effectiveness of the implemented security services and examine possible gaps that can expose sensitive information to the risks of vulnerabilities.

This study aims to offer empirical understanding of the applicability approaches to security system implemented in the social service agencies, regulations of Personal Data Protection Act (PDPA) and management of cyber security risks by conducting a structured study on the current data protection practices. This paper will also look at the most critical issues agencies deal with so that they can have healthy data security such as financial challenges, incompetence and limitations in their operations.

The final aim is to come up with a robust data security strategy that suits the requirements of social service agencies in such a manner that they would be able to secure sensitive information without reducing operational effectiveness and lawfulness. The results of the study will be of great use to policymakers, funding agencies, and agency leaders as they guide them in developing strategies to enhance data security infrastructure and reducing the possible risk of data breaches in the social services sector.

1.6 Significance of the Study

Data security is a critical concern for social service agencies that handle sensitive personal, financial, and health-related information of vulnerable populations. Ensuring robust data protection is essential for regulatory compliance, maintaining public trust, and ensuring service continuity. This study offers empirical insights into the challenges and best practices in data security management, which is significant for multiple stakeholders, including social service organisations, policymakers, funding bodies, and cybersecurity professionals.

1.6.1 Contribution to Social Service Agencies

This research will help funded social service agencies in Singapore assess the effectiveness of their existing data security protocols and identify gaps that may expose them to cyber threats or compliance risks. By providing a structured framework for improving data security, the study will offer practical recommendations for enhancing data protection while ensuring minimal disruption to daily operations.

1.6.2 Policy and Regulatory Implications

Given the stringent compliance requirements under Singapore's Personal Data Protection Act (PDPA) and other cybersecurity guidelines, this study will provide valuable insights for regulatory bodies. The findings can help policymakers refine data security policies for non-profit organisations and introduce more targeted support mechanisms to help social service agencies meet compliance standards efficiently.

1.6.3 Technological and Cybersecurity Advancements

This study will contribute to the growing body of knowledge on how social service agencies can adopt cost-effective security strategies by examining emerging cybersecurity solutions, such as cloud security, encryption technologies, and AI-driven threat detection. It will also provide insights into the feasibility of implementing advanced security frameworks tailored to non-profit organisations' financial and operational constraints.

1.6.4 Practical Benefits for Funding Bodies and Donors

For funding organisations and donors that support social service agencies, ensuring data security is crucial for sustaining trust and credibility. The study will highlight the importance of allocating resources towards cybersecurity infrastructure, encouraging more targeted investments in data protection technologies.

1.6.5 Academic Contribution

This research will fill a literature gap by focusing on data security challenges specific to social service agencies, which remain underexplored compared to corporate and financial institutions. By providing empirical evidence and a sector-specific security framework, the study will serve as a foundation for future research on cybersecurity best practices in non-profit sectors.

This study will address the interplay between regulatory compliance, operational challenges, and technological advancements, offering comprehensive, actionable insights for social service agencies, regulators, and funding bodies. The proposed security framework will help organisations enhance their cybersecurity posture, mitigate risks, and protect sensitive data, ultimately strengthening public confidence in social services.

1.7 Research Purpose and Questions

1.7.1 Research Purpose

This research paper aims to look at and improve data security in social service agencies in Singapore that receive funding. Because of the nature of sensitive personal, financial, and healthcare-based data that comes to hand of such organisations, they are highly vulnerable to cybersecurity risks, data breaches, and regulatory non-compliance. Even though countries have some legal systems like the Personal Data Protection Act (PDPA), several agencies lack the experience to apply a strong security system owing to limited funds, know-how, and business issues.

To carry out this research, the following is to be done:

Assess the existing data security provisions embraced by social service agencies.

Determine vulnerabilities and compliance issues which affect data protection.

Define a security improvement structure so that it would meet the regulatory provisions and the operational realities of these agencies.

The research shall enable social service agencies to advance the security of data infrastructure, dependability in regard to the regulations, and protection of sensitive data by offering empirical evidence on security risks in the cyber domain, best practices, and evidence-based strategies. Policymakers, funding organisations and IT professionals practicing in the social service sector will equally use the findings.

1.7.2 Research Questions

The following key research questions guide this study:

1. How do funded social service agencies in Singapore face the key challenges in implementing advanced data security measures?
2. How effective are the current incident response strategies in funded social service agencies in Singapore at mitigating data breaches?
3. What role do employee training and awareness programs play in enhancing data security protocols in funded social service agencies in Singapore?
4. How can collaboration between funded social service agencies in Singapore be improved to strengthen data security?
5. How can leaders foster partnerships with other funded social service agencies, government agencies, and cybersecurity experts to share best practices and resources and enhance the sector's overall security posture?

1.8 Scope and Limitations of the Study

This paper will criticize and improve on the data security practice of the funded social service agencies in Singapore. Coupled with increasingly relying on digital systems to handle sensitive data, social service agencies are, therefore, at expressive risk of cyberattacks that should be addressed in a sector-specific manner. The relevant social service agencies identified in the research are those, which are funded by the government or institutions and of which have to fall within the boundaries of a regulatory framework of Singapore. It contemplates the regulatory consequences of Personal Data Protection Act (PDPA) and other policies in cybersecurity that apply in the sector. The research evaluates the current cybersecurity implementation, risk mitigation systems, compliance systems based on the input of the agency IT managers, data protection officers, and leadership teams involved in the implementation of the security policies. Also, the paper examines the major cybersecurity threats including data breaches, unauthorized access, insider threats, and violation of compliance to ascertain how they affect service delivery and public confidence. The results will be used to inform the development of data security plans as well as enhance its regulatory compliance and resilience to cybersecurity threats in social service agencies.

Towards the end of the discussions, even though the study has been very important there are a few limitations that the study has which can impact on the generalizability of the study. First, it only focuses on funded social service agencies in Singapore, therefore the findings may be limited to organisations in the private sector or those in the non-profit prior working internally and they may be regulated differently. Also, the data accessibility can be a problem because there might be no large files of descriptions of cybersecurity incidents, and some agencies can have some confidentiality policies and not even share some essential information related to security. The research also depends on the self-reported data that is gained through a survey and expert interviews, and it can create certain biases, especially, when the respondents fail to report the security problems because of their image. Also, the fast-changing reality of cybersecurity threats also poses a bit of a challenge since new threats are being introduced and new technologies developed that might not be included in the study and it necessitates occasional reviews of the research and an update of its conclusions. The main constraint highlighted by Niphadkar (2016) is that most social service agencies work under a limitation of budget allocation and resources and are unlikely to suggest solutions that could not be used by many people due to its high costs that cannot be achieved within the allocated budget.

Nevertheless, the study has its strengths as it teaches us more about the issue of data security in social service agencies and learns more about necessary vulnerabilities that should be paid attention to. The results will be a feasible asset to the policymakers, fund organisations and the leaders in agencies who are interested in enhancing data protection frameworks that are relevant to the social service agency organisations. This research seeks to harmonise the gap between the moral requirements of compliance and the reality of the security practices and this is done by resolving regulatory and functional problems so that sensitive data in the social service sector in Singapore is safeguarded.

1.9 Conclusion

The chapter of introduction points out the necessity to improve the level of data security in funded social service agencies in Singapore, which is extremely high. Since these agencies handle very sensitive information related to the personal, financial, and healthcare spheres, they are experiencing more cybersecurity threats, complication to regulatory compliance, and limited operations. In spite of the established regulations on data protection that include Personal Data Protection Act (PDPA), recent breaches and vulnerabilities reveal that the current level of security is not enough to protect the sensitive data. The research highlights the increased dangers of cyber threats such as phishing activities, information leakage, and hacking that could affect trust, service delivery and attract penalties.

Since most social service agencies do not have sufficient resources or experts in the cybersecurity field, the application of long-term and cost-effective security standards is necessary. The study will conduct an evaluation of the existing security practices, localize the main risks, and design a more valuable model of cybersecurity taking into consideration the individual requirements of social service agencies. The study aims to offer evidence-based recommendations to guide policymakers, funding attorneys and agency heads towards enhancing data security practices through bridging the gap between regulatory demands and real challenges associated with data security implementation (Ch and Kuhil, 2017).

The chapter has also defined the limits, the importance of the study, and the aims of the research given the fact that protection of digital documentation as well as improvement of vigilance and business chains have become a necessity due to high digitalization of the social services sector. Finally, the results will help to make society more cybersecurity resilient, promote the financial sustainability of the social service agencies, and secure the sensitive data of vulnerable communities.

CHAPTER II:
REVIEW OF LITERATURE

2.1 Introduction

To guarantee that these organisations are performing well in terms of fulfilling their responsibilities, the Ministry of Social and Family Development (MSF) offers funding and guidance to ensure that they are well and able to support the people who are in need effectively. Singapore has an important social service industry that assists vulnerable populations, including children, elderly individuals, low-income families and people with disabilities. It is provided by the government agencies, non-profit organisations, and community-based groups and offers the necessary support such as medical care, education, shelter and financial help. Since the government and the community invest in these agencies, it is crucial to secure the sensitive personal information that they deal with. Data security has taken pole position in the social service organisations because sensitive data such as financial records, medical records, and personal identifying information is collected and processed in these organisations. Any security breach may lead to identity theft, monetary fraud, and tainting of reputational damages and, in the long run, decrease the quality of service provided to those in greatest need. The Singaporean government has reacted to these menaces in this way by passing such laws as the Personal Data Protection Act (PDPA) that requires social service providers to handle their data in a stringent data security and privacy rules. Nevertheless, due to lack of funding, lack of experience, developing nature of cyber threats as well as interagency collaboration challenges, a significant number of agencies continue to struggle with implementing and preserving effective cybersecurity processes.

The purpose of this literature review is to explore the status quo about the safety of information in the social care institutions, which the government of Singapore supports. It is going to review the current data protection regulations and policies, investigate the issue of data security implementations by the social service organisations, determine new trends and cybersecurity best-practices, and suggest an improvement to data security policies and frameworks. The paper shall also consider the perceptions of other inquiries made all over the world in regard to security of data in social services as compared to the Singapore laws against the international best practices to point out any potential action of improvement.

In as much as this study is extensive, it is imperative to acknowledge its limitations. Singapore policies and practices are the major focus of the research, but there is the possibility that new security questions and legislative changes are going to appear due to the rapid development of technology. Due to this, social service organisations must keep on updating their cybersecurity plans to keep up with the ever-changing trend in cyberspace. In the enhancement of data security, leadership in social service organisations is very essential. To make governance effective, employees must be trained on proper cybersecurity procedures, fitted with the latest security technologies and prepared in case of any data breach. By putting the investment into data security first, social service organisations can better secure sensitive information, maintain the confidence of people and continue delivering the needed services without disruption as required by law and nurturing a culture of cybersecurity protection.

This literature review is going to critically analyse available literature, regulatory guidelines, case studies, and technological development in a bid to have a comprehensive knowledge on how the social service agencies in Singapore can improve their data security procedures. This analysis will help the research develop initiatives into more productive cyber resilience strategies that will enable social service organisations to be safeguarded against the potential emerging threats without forgetting the pledge of ensuring that the community is secured as initiated by the organisation.

2.2 Challenges in Data Security for Resource-Constrained Environments

2.2.1 Funding Gaps & Resource Constraints in Data Security

The effect of resource limitations presents serious issues pertinent to institute substantial data security measures in the embedded system and IoT devices. Shortage of processing power, memory and energy resources lead to a so-called security processing gap and a battery gap (Ravi et al., 2004). Because of those restrictions, lightweight cryptography algorithms and good energy consumption methods need to be created (Rozlomii et al., 2024). Devices of limited resources do not require conventional security methods since they often require the deployment of large processor resources (Mishra, 2015). Scientists have developed new methods of addressing these issues, such as the security fusion, where the resources used are minimized with the compromise of process-level security not decreasing because weaker qualities of point-to-point security are fused into producing stronger security properties (Nair et al., 2013). It is also necessary to have flexible security provisions that adapt to fluctuations in operations and limitations of available resources (Rozlomii et al., 2024). Future studies aim to deliver comprehensive solutions that sought the maximisation of productivity and security through the convergence of managerial, software, and hardware components in resource-scarce environments (Rozlomii et al., 2024).

2.3 Data Security Challenges in Social Service Agencies

2.3.1 Data Security Challenges for Funded Social Service Agencies in Singapore

The following are some of the main challenges that social service agencies in Singapore encounter on the way of introducing advanced data security measures. These comprise the difficulty in modelling, data governance, and data analysis, more so small and medium-sized businesses (Perdana et al., 2020). The unique social service context of Singapore prevents the interaction of primary care teams and community case managers, a factor that has impact on the continuity of patient treatment (Yeo et al., 2021). Organisational structure and confidentiality cause data sharing and integration initiatives to be more complicated (Yeo et al., 2021). Moreover, social workers have an even harder time because of the COVID-19 epidemic (Chung, 2022). The involvement of community partners, monitoring of the internal change process, and ensuring that new technology is used to support social service referrals are also a problem within organisations because of the privacy requirements (Cartier et al., 2020). The use of more advanced data security systems, appropriate finance models, and timely collaboration with social services partners requires stronger evidence of effectiveness to eliminate these hurdles (Cartier et al., 2020).

2.3.2 Inter-Agency Coordination & Data Security Effectiveness

The coordination in between the agencies is basically vital in upgrading data security efficacy in various spheres. Digital transformation allows enjoying better information sharing and security activities among agencies (Колмыкова et al., 2023). Even though capacity and autonomy matters could restrict efficacy, official agreements and unofficial connections facilitate participation in the management of digital platforms in Brazil (Kira, 2024). Nevertheless, despite the current problems, the Norwegian approach to avoiding the crime aspect of work demonstrates how a second-order organisational structure may supplement the traditional type of sector-based units and lead to a more unified response (In Norway et al., 2020). Cybersecurity is perceptually detached in that individual self-efficacy and workgroup information security effectiveness are mediated by the workgroup-level modes (such as collective efficacy and security knowledge coordination) (C. Yoo et al., 2020). These studies all point out the fact that interagency coordination is a very significant aspect when addressing complex security situations in different contexts.

2.3.3 Effectiveness of Incident Response in Singapore’s Funded Social Services

Current incident response strategies in Singapore's financed social care institutions encounter hurdles in preventing data breaches. According to research, successful incident response requires the development of information security-conscious care behaviour (Adlyn Adam Teoh et al., 2022). Data breaches in the human services industry can be considerably decreased by expanding information assurance practices (Chevroen Washington et al., 2022). In order to continue providing support services during the COVID-19 epidemic, certain social service organisations in Singapore that deal with cancer modified their outreach tactics to use Facebook and other social media platforms (Kieran Ethan Tan et al., 2020). Tabletop exercises (TTXs) have become a popular training technique for enhancing incident response skills. TTXs boost cybersecurity incident response teams' (CSIRTs) knowledge and readiness, aid in the development of technical and non-technical skills necessary for managing security crises, and improve strategic decision-making (Giddeon N. Angafor et al., 2020). These results emphasise how crucial it is for social service organisations to continuously train their staff and modify their incident response plans.

2.4 Enhancing Cyber-security Through Employee Training & Awareness

2.4.1 Employee Training & Awareness in Singapore's Social Service Data Security

Employee training and awareness programs are critical in helping organisations improve their data security policies. Enhancing employee security behaviour and understanding is the goal of Security Education, Training, and Awareness (SETA) programs (Moneer Alshaikh et al., 2021). A social marketing strategy is required for more successful results because present SETA programs frequently prioritise knowledge acquisition over behaviour modification (Moneer Alshaikh et al., 2021). Building security awareness campaigns and conducting quarterly staff performance reviews are crucial success elements for the efficacy of the SETA program (Areej Alyami et al., 2023). Diverse approaches, including interactive seminars, simulated phishing exercises, and gamified learning platforms, are used in successful cybersecurity awareness initiatives (Temitayo Oluwaseun Abrahams et al., 2024). Maintaining cybersecurity activities requires employee accountability and involvement (Temitayo Oluwaseun Abrahams et al., 2024). Maintaining cybersecurity activities requires employee accountability and involvement (Temitayo Oluwaseun Abrahams et al., 2024). Innovative training methods that integrate Lean Six Sigma and Creative Problem-Solving tools can greatly enhance employees' innovative work behaviour and creative role identity in the public sector (Amy B. C. Tan et al., 2023).

2.4.2 Stakeholders & Leadership in Cybersecurity Adoption

Effective cybersecurity necessitates the participation of a wide range of stakeholders, including board members, CISOs, managers, and legal professionals. Diverse viewpoints are necessary since no single group of specialists consistently makes better security recommendations (Ben Shreeve et al., 2020). When responding to ransomware attacks and other cybersecurity risks, businesses have ethical obligations to stakeholders (Morgan &

Gordijn, 2020). Enhancing cybersecurity resilience requires data governance, which includes technology, rules, and processes that are in line with the overarching plan (Kumar et al., 2024). Real-time monitoring, data classification, and access control are important components (Kumar et al., 2024). Implementing successful cybersecurity strategies requires cyber governance, which involves all stakeholders in management procedures (Savaş & Karatas, 2022). A general governance framework has not yet been established, despite the fact that some nations have local cybersecurity governance solutions (Savaş & Karatas, 2022). This emphasises the necessity of a thorough strategy for cybersecurity that takes into account the opinions of various stakeholders and strong governance frameworks.

2.4.3 Regulatory Compliance in Funded Social Service Agencies

In social service organisations, numerous organisational and structural elements have a role in regulatory compliance. According to Adebayo et al. (2024), strong data governance frameworks are essential for guaranteeing adherence to legal and regulatory obligations. In health and social care contexts, compliance is positively correlated with smaller facilities, higher nurse-staffing levels, and lower staff turnover (Dunbar et al., 2022). To match activities with external norms and regulations, organisations have created accountability infrastructures that include offices, roles, and procedures (Huising & Silbey, 2021). Principles of pragmatic philosophy, like inquiry through narrative and context adaptability, are incorporated into these infrastructures. Stakeholders want stable representations of government, therefore there are conflicts when describing pluralism and experimentation (Huising & Silbey, 2021). To improve compliance, researchers suggest focusing on the organisational coalface, examining how regulated parties manage themselves, and analyzing the implications of tensions in narrating adaptation and experimentation (Huising & Silbey, 2021; Dunbar et al., 2021).

2.5 Role of Technology and Automation in Data Security

2.5.1 Risks & Benefits of Automation in Social Service Data Protection

Automation in data protection within social services has both potential benefits and hazards. Although it can boost productivity and enable resource reallocation (Svensson, 2020), it also presents security and privacy issues (Carmichael et al., 2024). Because automated procedures mostly rely on structured data, they run the risk of dehumanising case administration and impairing claimants' capacity to fully state their claims (Enqvist, 2023). Concerns regarding accountability and digital dignity are raised by the digitisation of beneficiary identification and registration systems, even if it can make the shift from humanitarian aid to government provision easier (Faith & Roberts, 2022). Constant evaluation of the effect on claimants and adherence to regulatory guidelines are required (Enqvist, 2023). Furthermore, there is a lack of information about the effects of algorithmic management and biometric identification on disadvantaged populations (Faith & Roberts, 2022). One of the biggest challenges facing social services is juggling the advantages of automation with possible threats to security, privacy, and individualised treatment.

2.5.2 Long-Term Implications of AI-Driven Cybersecurity in Social Services

AI integration in cybersecurity and social security offers both possibilities and difficulties. In social services, AI can improve consumer interactions, combat fraud, and improve service delivery (Hassan BENOUACHANE, 2022). AI in cybersecurity provides enhanced reaction capabilities, more precise risk assessment, and quicker attack detection (Yijie Weng & Wu, 2024). Implementing AI, however, brings up issues with data protection and the requirement for human control. Further research is necessary due to the long-term effects of AI on science, collaboration, power dynamics, epistemics, and values (Clarke & Whittlestone, 2022). Organisations must use a variety of strategies, such as strong threat intelligence and adaptive defence mechanisms, as AI-driven cyberthreats get more complex (Familoni, 2024). In order to ensure accountability and ethical compliance, regulatory frameworks and industry standards play a critical role in forming AI-powered cybersecurity solutions. Effectively managing the changing threat landscape requires interdisciplinary cooperation and investments in cybersecurity education.

2.6 Strengthening Data Security Through Best Practices & Capacity-Building

2.6.1 Expertise & Capacity Limitations in Social Service Cybersecurity

Cybersecurity research concerning social services shows limitations of expertise and capacity. Most of the time, boards tend to be without cybersecurity expertise, they do not get the oversight that leaves them to be dependent on the management's potentially biased information (Lowry et al, 2021). Resource constraints, low IT usage and low awareness of cybersecurity schemes are obstacles that social enterprises have to face (White et al., 2020). Barriers as to why some groups, such as the elderly, disabled and oppressed people, are difficult to implement cybersecurity due to barriers (Chowdhury, Renaud, 2023). However, national development and scale of Internet use have a tremendous influence on the cybersecurity capacity building, with the contra, some countries are over a, or under a, performer compared to these factors (Creese et al., 2021). This calls for more effective cybersecurity education, targeted strategies considering socio-economic circumstances for cyber resilience of these orgs, and more importantly, for the social services orgs to think about the potential of including crypto in payment options without compromising their objectives and ideal conditions.

2.6.2 Best Practices for Data Security in Social Service Agencies

Best practices for ensuring data security in social service agencies involve implementing robust procedures for informed consent, privacy protection, encryption, and access control (Adekugbe & Ibeh, 2024). Organisations should establish ethical decision-making frameworks, conduct regular audits, and provide staff training to address data management challenges (Adekugbe & Ibeh, 2024). Risk management strategies are crucial, as cybersecurity threats in healthcare are particularly prevalent (Dias et al., 2021). While no method is fully effective against cyber criminals, integrating cybersecurity into management processes is essential (Dias et al., 2021). Collaborative projects with non-academic partners require special attention to data security obligations (Milliff, 2020). Implementing off-the-shelf tools can help mitigate security threats in such partnerships (Milliff, 2020). Additionally, organisations should consider adopting a "caring data practice" that prioritizes relationships and community context and protects vulnerable populations through non-collection when appropriate (Boone et al., 2023).

2.6.3 Future Research & Policy Development in Social Service Data Security

Future research and policy development in data security for social services should focus on several key areas. These include addressing security and privacy concerns in assistive robotic systems for healthcare, particularly for older adults (Marchang & Nuovo, 2022). Developing innovative security technologies, improving data security awareness, and exploring ethical and legal aspects of data security are crucial (Febriyani et al., 2023). The human dimension in managing risks and benefits of digital data in social security administration needs reinforcement (Lee-Archer, 2023). Additionally, ensuring social equity in data-driven public services requires attention to mechanisms related to data collection, storage, analysis, and usage (Ruijer et al., 2022). Blockchain technology, resource-aware frameworks, and continuous multifactor authentication are potential solutions for enhancing security in assistive robotic systems (Marchang & Nuovo, 2022). Future research should also focus on balancing system usability with security measures and addressing scalability challenges in data security (Febriyani et al., 2023).

2.7 Building Resilient Cyber-security Strategies for Social Services

2.7.1 Strengthening Cyber-security Through Capacity-Building

Capacity-building initiatives are crucial for organisations to overcome cybersecurity challenges. Research shows that higher levels of cybersecurity capacity maturity lead to positive outcomes for nations (Creese et al., 2021). These initiatives encompass education, training, technology standards, and legal frameworks (Creese et al., 2020). However, many countries, particularly in Africa and Latin America, face significant challenges in developing cybersecurity human capital due to rapid technology adoption outpacing skill acquisition (Ramim & Hueca, 2021; Contreras & Barrett, 2020). International cooperation, such as the U.S. Department of State's programs, can help address these challenges (Ramim & Hueca, 2021). Despite the importance of cybersecurity capacity building, it often competes with other national priorities for funding (Contreras & Barrett, 2020). A capacity divide exists between countries based on income levels, reinforcing economic disparities (Creese et al., 2020). Empirical evidence supports investing in cybersecurity capacity-building efforts to enhance national and organisational resilience against cyber threats.

2.7.2 Enhancing Collaboration for Data Security in Singapore’s Social Services

Improving collaboration between funded social service agencies in Singapore to strengthen data security requires addressing several challenges. These include self-identity, inter-professional factors, confidentiality, and organisational structure unique to Singapore's healthcare landscape (Yeo et al., 2021). Developing best practices for data security in practitioner-academic partnerships involves identifying obligations, threats, and appropriate security measures (Milliff, 2020). Collaborative care structures can play a vital role in managing data for vulnerable populations, with attention to 'matters of care' helping to reduce harm and improve data quality (Slota et al., 2023). To enhance collaboration, it is essential to actively engage community case managers with primary care teams, overcoming the current perception of them as non-members of the healthcare team (Yeo et al., 2021). Implementing off-the-shelf tools and establishing discipline-wide best practices can also improve data security in collaborative projects (Milliff, 2020).

2.8 Literature gaps

While much study has been done on data security measures, resource limits, and inter-agency collaboration, there are still substantial gaps in understanding the unique issues that government-funded social care providers face in Singapore. The majority of the literature now in publication is on the technological facets of cybersecurity in broad sectors such large corporations, healthcare, and finance. However, few studies have examined the particular limitations, governance issues, and operational difficulties of data security in the social services industry.

One of the primary gaps is the lack of targeted research on funding and resource constraints in implementing data security for social service agencies. Studies show that processing power and battery limitations limit security measures in embedded systems and IoT devices (Ravi et al., 2004; Rozlomii et al., 2024). However, little is known about how these issues affect government-funded and non-profit organisations that might not have the financial or technical means to invest in cutting-edge cybersecurity infrastructure. Because of the particular limitations faced by the social services industry, investing in cybersecurity is frequently neglected in favour of service delivery, a problem that has not received much attention in recent studies.

There exists another gap regarding our understanding of challenges of data governance and interagency coordination in Singapore context. Some research has undertaken on data sharing difficulties, confidentiality concerns, as well as impact of the digital transformation to interagency security (Колмыкова et al., 2023; Kira, 2024), but it has been related mostly to the work with the government or corporate sectors, and these sectors are largely different from the social service agencies, which work with highly sensitive piece of data and lack the very fragmentation of the digital infrastructures. In addition, social services compliance complicates inter-agency collaboration, which impedes progress, and standardized protocols, not to mention silos in administration, are sorely lacking. However, there is little empirical data on those issues in particular.

In addition to that, the lines of incident response in social service agencies have not been examined as thoroughly as the private sector. Several of the studies emphasize the role of cybersecurity awareness and training programs (Adlyn Adam Teoh et al., 2022), but there is not much work identifying what existing incident response measures seem to be behind the wheel in the social services and how they compare to other sectors like healthcare or the financial institutions. Despite the shortage of TTXs for cybersecurity training both narrowly and broadly defined, the corpus of research for corporate and government security teams has yet to tackle social service agencies, leaving many questions about their readiness for handling cyber attacks.

Additionally, most of the studies regarding employee training and awareness in cybersecurity focus on Security education, Training, and Awareness (SETA) and point out the figures of effectiveness mostly in knowledge capacity rather than behavioural change (Alshaikh Moneer et al., 2021). Research on tailored cybersecurity training concepts tailored to the specific social services workforce dynamics, skill levels, and operational challenges unique to these agencies is lacking in Singapore's social services context. It is still necessary to study employee engagement, accountability and practical security awareness measures to improve compliance as well as mitigate risk in these organisations.

Another research gap involves automation of cybersecurity solutions driven by AI. Existing work has explored automation in social service data protection (Carmichael et al., 2024), but the relationship between security automation and the non-security dimensions such as privacy concerns and human oversight are unstudied. There are studies on biometric identification, algorithmic management, and data security for vulnerable populations (Faith & Roberts, 2022) of great risk. Nevertheless, there is still little research on how automation changes data protection in Singapore's social service agencies.

Finally, the long term effects of AI lead to social services cybersecurity are not explored. Although it is recognized that AI has great potential in improving cybersecurity, fraud detection and incident response (Yijie Weng & Wu, 2024), AI deployment has not been developed in the social services field except for theory. Little empirical research has been done to describe how such AI driven security measures can be properly implemented in government funded social service agencies that face financial constraints, ethical concerns, and data sharing complex situations.

Future research should focus on developing cybersecurity frameworks explicitly tailored for social service agencies, incorporating funding constraints, inter-agency coordination challenges, and workforce training limitations to bridge these gaps. Additionally, comparative studies with other sectors, policy-driven research, and the evaluation of AI-based security models in social services will be crucial for advancing knowledge in this area. By addressing these research gaps, policymakers and social service agencies can develop more effective, sustainable, and adaptable data security strategies that protect organisational integrity and the vulnerable populations they serve.

2.9 Conclusion

This literature review highlights the critical challenges, regulatory frameworks, and emerging trends in data security for funded social service agencies in Singapore. The review explores key areas such as funding constraints, inter-agency collaboration, incident response strategies, employee training, and AI-driven cybersecurity. While Singapore's Personal Data Protection Act (PDPA) provides a strong regulatory framework, the findings indicate that many agencies struggle with compliance due to resource limitations, fragmented digital infrastructures, and evolving cyber threats.

A major challenge identified is the financial and operational constraints that prevent social service agencies from investing in robust cybersecurity measures. Inter-agency coordination issues further complicate data governance, as confidentiality concerns and compliance complexities hinder efficient data-sharing practices. The review also reveals gaps in incident response preparedness, where social service agencies lack structured cybersecurity training, tabletop exercises (TTXs), and sector-specific security frameworks compared to industries like healthcare and finance.

Employee training and cybersecurity awareness programs, while widely recognized, often focus on knowledge acquisition rather than behavioral change, limiting their effectiveness in mitigating security risks. The literature also identifies the potential role of AI and automation in improving cybersecurity defenses, yet research on the real-world implementation of AI-driven security solutions in social service agencies remains limited. Concerns related to privacy risks, human oversight, and ethical governance in AI applications require further investigation.

Despite significant advancements in cybersecurity research, this review identifies notable gaps in funding models, regulatory compliance strategies, incident response mechanisms, and AI adoption in social service agencies. The findings underscore the need for future research to develop cybersecurity frameworks specifically tailored for social services, focusing on financial limitations, governance challenges, and employee training strategies. Comparative studies with other sectors, policy-driven research, and AI-based security models will be crucial in strengthening cybersecurity resilience in social service agencies.

CHAPTER III:
METHODOLOGY

3.1 Overview of the Research Problem

The research problem addressed in this study focuses on the growing cybersecurity vulnerabilities in funded social service agencies in Singapore. These agencies handle highly sensitive personal data, including financial records, medical information, and personally identifying details of vulnerable populations such as low-income families, individuals with disabilities, and older people. Despite the critical importance of data security, many of these agencies face significant challenges in implementing and maintaining robust security protocols due to limited financial resources, lack of technical expertise, and regulatory complexities. The Personal Data Protection Act (PDPA) and Cyber Security Act (CSA) impose strict data protection requirements, yet compliance remains inconsistent due to organisational constraints. Recent data breaches in social service sectors worldwide have highlighted gaps in cybersecurity training, incident response preparedness, and inter-agency collaboration.

Additionally, existing studies on cybersecurity risks and protective measures primarily focus on corporate or healthcare organisations, leaving a significant gap in understanding the unique security challenges faced by nonprofit, government-funded social service agencies. This research seeks to analyse these challenges, assess current security frameworks, and propose actionable strategies to enhance data protection, ensure regulatory compliance, and strengthen inter-agency collaboration in Singapore's social service sector. By addressing these gaps, the study aims to provide practical insights to policymakers, agency leaders, and IT professionals, ensuring a more resilient and secure digital environment for social service agencies.

3.2 Operationalization of Theoretical Constructs

This study operationalises theoretical constructs to quantify key variables related to data security within funded social service agencies in Singapore. The primary constructs include data security effectiveness, compliance with regulatory standards, cybersecurity training adequacy, and incident response efficiency. Each construct is measured using structured survey responses collected from key personnel within these agencies, such as IT managers, data protection officers, and administrative staff.

Data security effectiveness is assessed through indicators such as the presence and implementation of encryption protocols, access control mechanisms, and multi-factor authentication. Compliance with regulatory standards, particularly the Personal Data Protection Act (PDPA) and the Cyber Security Act (CSA), is quantified based on agencies' adherence to mandated security practices, audit frequency, and reported compliance challenges. Cybersecurity training adequacy is evaluated through metrics such as training frequency, staff participation rates, and the perceived impact of training programs on reducing security incidents. Incident response efficiency is measured using variables such as the response time to security breaches, the existence of predefined incident response plans, and the effectiveness of corrective measures taken after a breach.

All variables are operationalised through structured survey items utilising Likert-scale responses, categorical choices, and numerical inputs, ensuring objective quantification. Statistical techniques such as correlation analysis, regression modelling, and hypothesis testing will be applied to analyse the relationships between these constructs. This approach ensures a data-driven evaluation of cybersecurity practices, identifying areas for improvement and guiding policy recommendations for strengthening data security within Singapore's social service sector.

3.3 Research Purpose and Questions

This research aims to assess the effectiveness of data security protocols in funded social service agencies in Singapore. These agencies handle sensitive personal data, making them susceptible to cybersecurity risks. Despite regulatory frameworks such as the Personal Data Protection Act (PDPA) and the Cyber Security Act (CSA), many agencies face challenges implementing robust security measures due to financial constraints, limited technical expertise, and inconsistent cybersecurity training. This study aims to identify the key challenges affecting data security, evaluate the effectiveness of existing security measures, and determine the impact of factors such as agency size, funding levels, and training frequency on cybersecurity outcomes. The findings will provide empirical evidence to inform policy decisions and optimise security strategies for improved compliance and risk mitigation.

To achieve these objectives, the study addresses the following research questions: What are the key challenges funded social service agencies face in implementing advanced data security measures?

How effective are security protocols in mitigating data breaches and ensuring compliance with PDPA and CSA regulations?

What is the relationship between cybersecurity training frequency and data breach occurrences in these agencies?

How does funding allocation impact the implementation of security measures and overall cybersecurity posture?

How can inter-agency collaboration improve data security effectiveness across the social service sector?

These questions will be analysed using structured survey responses and statistical techniques to generate data-driven insights that enhance cybersecurity resilience in social service agencies.

3.4 Research Design

The research design for this study follows a quantitative approach, utilising structured surveys and statistical analysis to evaluate data security protocols in funded social service agencies in Singapore. A cross-sectional survey will collect primary data from IT managers, data protection officers, and administrative staff responsible for cybersecurity implementation within these agencies. The study focuses on measuring key variables such as compliance with the Personal Data Protection Act (PDPA) and Cyber Security Act (CSA), effectiveness of security measures, frequency of data breaches, adequacy of cybersecurity training, and funding constraints.

The survey instrument consists of closed-ended and Likert-scale questions designed to quantify perceptions, practices, and challenges related to data security. A purposive sampling strategy will be used to gather responses from agencies of different sizes and funding levels to enhance the generalizability of findings. Data analysis will involve descriptive statistics, correlation analysis, and multiple regression modelling to identify significant trends and relationships between security measures, compliance levels, and agency characteristics.

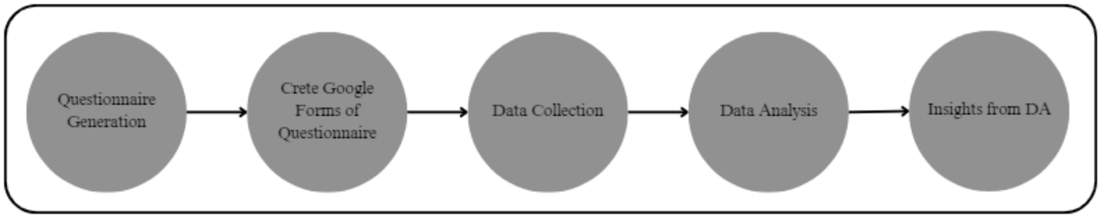

Figure 1 Research Design Map for Data Analysis

By adopting this structured and objective research design, the study aims to provide empirical evidence on the effectiveness of current data security protocols, identify gaps in existing practices, and offer data-driven recommendations to enhance cybersecurity measures within Singapore’s social service sector.

3.5 Literature Review on Data Security Protocols in Funded Social Service Agencies

Objective:

To conduct a comprehensive literature review to identify key theories, concepts, and gaps in the existing knowledge related to enhancing data security protocols in funded social service agencies in Singapore.

Methodology:

The methodology involves a structured review of relevant literature to build a strong theoretical foundation for the study. The literature review will focus on identifying key themes in data security, regulatory frameworks, cybersecurity threats, and the effectiveness of current security measures within social service agencies. Academic journal articles, industry reports, government policies, and case studies will be systematically analysed to highlight existing knowledge and research gaps.

The literature search will be conducted using academic databases such as Google Scholar, IEEE Xplore, ScienceDirect, and SpringerLink, ensuring that only peer-reviewed and high-impact sources are included. Keywords such as "data security in social services," "cyber threats in nonprofit organisations," "Singapore PDPA compliance," and "cybersecurity challenges in social service agencies" will be used to retrieve relevant studies. The inclusion criteria will focus on research published within the last 10 years to ensure that the findings reflect current trends in data security and evolving cybersecurity threats. Additionally, relevant government reports and regulatory documents, particularly those issued by Singapore's Cyber Security Agency (CSA) and the Personal Data Protection Commission

(PDPC), will be examined to understand social service agencies' legal requirements and compliance frameworks.

By conducting this structured literature review, the study aims to establish a conceptual framework that links theoretical knowledge with practical challenges in enhancing data security protocols within Singapore's funded social service agencies. The findings from this review will guide the development of research hypotheses and inform subsequent methodological choices in data collection and analysis. This approach ensures that the study is built on a well-researched foundation, allowing for a more robust and evidence-based investigation into data security challenges and improvements in the nonprofit sector.

3.6 Developing a Rigorous Research Methodology for Data Security Assessment

Objective:

To design and implement a rigorous research methodology that addresses the limitations and gaps in previous studies, ensuring data validity and reliability.

Methodology:

The study will adopt a quantitative approach, incorporating structured surveys and statistical analyses to ensure data accuracy and generalizability. This methodology is designed to overcome the limitations of prior research, particularly the lack of empirical studies focused on data security challenges within funded social service agencies in Singapore. A cross-sectional survey will target key stakeholders such as IT managers, data protection officers, administrative staff, and leadership teams in social service agencies. The survey will collect primary data on cybersecurity practices, regulatory compliance, funding limitations, staff training, and incident response strategies.

To ensure the research instrument's validity, the survey will be pre-tested through a pilot study with a small group of respondents before full-scale distribution. This pilot phase will help refine the questionnaire by identifying ambiguities and ensuring the questions effectively capture the intended information. The final survey will include closed-ended, Likert-scale, and multiple-choice questions, allowing for quantitative measurement of responses. The study will employ a purposive sampling strategy to select agencies based on size, funding model, and data security maturity. A minimum sample size will be determined using statistical power analysis to ensure robust and reliable results.

The data collection will be conducted through online survey platforms and email invitations, ensuring broad participation while maintaining data confidentiality. Ethical considerations will be strictly adhered to, including informed consent, anonymity, and compliance with Singapore's Personal Data Protection Act (PDPA). The collected data will undergo data cleaning and preprocessing, including handling missing values, removing inconsistencies, and standardising responses to improve data quality.

Statistical software such as Python will be used to perform descriptive and inferential data analyses. Descriptive statistics will summarise key findings related to agency demographics, cybersecurity practices, and compliance levels. Inferential tests, including Chi-Square analysis, ANOVA, and Pearson correlation tests, will be used to examine relationships between different variables, such as the impact of funding levels on cybersecurity readiness or the effectiveness of staff training programs in preventing data breaches. These tests will help identify statistically significant patterns, ensuring that findings contribute meaningful insights to the research problem.

By implementing this rigorous methodology, the study aims to provide empirical evidence on data security challenges, offering a data-driven foundation for policy recommendations and cybersecurity improvements in funded social service agencies. This approach ensures the findings' reliability, validity, and replicability, filling existing research gaps and contributing to the broader discourse on cybersecurity in nonprofit organisations.

3.7 Quantitative Data Collection and Analysis of Cybersecurity Practices

Objective:

To collect and analyse primary data through quantitative methods to examine the relationships, patterns, and trends within the research area.

Methodology:

The study will employ a quantitative approach to ensure a comprehensive analysis of data security protocols in funded social service agencies in Singapore. The primary data collection will be structured to capture insights from key stakeholders, including IT managers, data protection officers, administrative staff, and agency leaders, who are directly involved in data security implementation and compliance.

The quantitative component will consist of a structured survey to measure the effectiveness of existing cybersecurity measures, regulatory compliance, funding limitations, and employee training in social service agencies. The survey will quantify responses using closed-ended, Likert-scale, and multiple-choice questions, ensuring statistical reliability. A purposive sampling technique will target agencies based on key criteria such as size, funding model, and cybersecurity maturity. The survey will be distributed online to maximize response rates while ensuring participant anonymity and compliance with Singapore's Personal Data Protection Act (PDPA).

The collected data will be subjected to rigorous statistical analysis using tools like Python, applying descriptive statistics (e.g., frequency distributions, means, and standard deviations) to summarize the data and inferential statistics, including Chi-Square tests, ANOVA, and Pearson correlation analysis, to examine relationships between variables such as funding levels, cybersecurity training, and frequency of data breaches.

This methodology will provide an evidence-based analysis of data security measures in social service agencies. It will identify patterns and trends that can inform policy recommendations, training programs, and funding strategies to enhance cybersecurity resilience.

3.8 Developing a Conceptual Framework for Data Security Enhancement

Objective:

To develop a conceptual framework or theoretical model that provides a comprehensive understanding of the factors and mechanisms influencing data security protocols in funded social service agencies in Singapore.

Methodology:

The study will employ a quantitative research approach to establish statistical relationships between key variables affecting data security. The conceptual framework will be developed based on empirical findings from structured surveys administered to key personnel, including IT managers, data protection officers, and administrative staff within funded social service agencies.

The survey will capture quantifiable data on cybersecurity protocols, funding constraints, regulatory compliance, and staff training effectiveness. All survey questions will be closed-ended to ensure objectivity and facilitate statistical analysis. A Likert scale (ranging from strongly disagree to agree strongly) will be used for most responses, allowing the study to measure perceptions of data security effectiveness, compliance challenges, and resource adequacy. A purposive sampling method will be applied to ensure representation across different types of agencies, categorized by funding models, size, and cybersecurity maturity.

Once the survey data is collected, exploratory data analysis (EDA) will be performed to clean and preprocess the dataset, ensuring accuracy and consistency. Descriptive statistics will summarize key findings, providing an overview of cybersecurity adoption trends across different agencies. Inferential statistical tests, including Chi-Square analysis, Analysis of Variance (ANOVA), and Pearson correlation tests, will be conducted to identify statistically significant relationships between variables such as funding levels and cybersecurity effectiveness, employee training and incident response efficiency, and compliance levels and frequency of security breaches.

The findings from these statistical analyses will serve as the empirical foundation for developing the conceptual framework. The framework will illustrate key relationships among data security challenges, resource allocation, regulatory compliance, and cybersecurity preparedness within funded social service agencies. The model will be validated through statistical regression analysis, ensuring that identified relationships hold predictive value.

By following this rigorous quantitative approach, the study will produce an evidence-based conceptual model that can be used to guide future data security policies, funding allocations, and cybersecurity best practices in social service agencies. This framework will provide a structured representation of critical factors influencing data security, enabling decision-makers to implement more targeted and data-driven security measures. The reliance on primary, quantitative data ensures that the study maintains a high level of validity and reliability, contributing significantly to academic and practical discussions on cybersecurity in the nonprofit sector.

3.9 Statistical Analysis of Cybersecurity Training, Compliance, and Funding Impact

Objective:

To explore the statistical relationships between cybersecurity training, regulatory compliance, funding allocation, and the effectiveness of data security measures within these agencies.

Methodology:

The study will employ a quantitative research approach to analyse the perspectives of key stakeholders on data security challenges and best practices. It will be conducted using structured surveys targeting board members, IT managers, data protection officers, administrative staff, and other key personnel involved in data security within funded social service agencies. The survey will measure stakeholders' perceptions of cybersecurity effectiveness, funding adequacy, regulation compliance, and challenges in implementing robust data security measures.

The survey design will include closed-ended questions and Likert-scale responses to ensure numerical data that can be statistically analysed. A purposive sampling technique will select participants from various agency types, ensuring representation across different funding structures and operational scales. The questionnaire will cover data protection policies, training effectiveness, resource allocation, and cybersecurity awareness among staff.

Once data collection is complete, exploratory data analysis (EDA) will be conducted to clean and preprocess the dataset. Descriptive statistics will summarize the key response trends, highlighting general perceptions of data security across different stakeholder groups. Inferential statistical methods, including Chi-Square tests, ANOVA, and correlation analysis, will determine statistically significant relationships between stakeholder roles and their perspectives on cybersecurity challenges.

The findings will provide quantifiable insights into the attitudes and readiness of different stakeholders in implementing data security protocols. These results will contribute to policy recommendations and security framework enhancements, ensuring agencies can optimize their cybersecurity strategies based on stakeholder-driven data insights. By maintaining a rigorous quantitative approach, this study will ensure data-driven conclusions that are statistically validated and applicable across the social service sector in Singapore.

3.10 Population and Sample

The population for this study consists of funded social service agencies in Singapore, specifically organisations that handle sensitive personal data related to healthcare, financial assistance, and social welfare. These agencies include government-funded, private, and non-profit organisations that must comply with Singapore's Personal Data Protection Act (PDPA) and other cybersecurity regulations.

The sample is drawn from key personnel within these agencies who are directly involved in data security management, compliance, and decision-making. This includes:

IT Managers

Data Protection Officers

Administrative Staff

Board Members

Senior Leadership Teams

A purposive sampling method is used to ensure the inclusion of agencies of various sizes and funding structures. The survey is distributed to 229 respondents, ensuring statistical reliability. The sample includes organisations with different employee sizes, funding sources, and levels of cybersecurity implementation to provide a comprehensive and generalizable dataset for analysis.

This structured sampling ensures that findings accurately reflect the real-world challenges and practices in enhancing data security protocols across different types of funded social service agencies in Singapore.

3.11 Participant Selection

The participant selection for this study follows a purposive sampling approach, ensuring that respondents are directly involved in data security management, compliance, and decision-making within funded social service agencies in Singapore. The study targets IT managers, data protection officers, administrative staff, board members, and senior leadership teams, as these individuals are responsible for implementing cybersecurity policies and ensuring compliance with Singapore's Personal Data Protection Act (PDPA).

Agencies of varying sizes, funding structures, and cybersecurity maturity levels were included to ensure a representative sample. Organisations were categorized based on employee size, funding sources (government-funded, private, or non-profit), and operational scope to capture a diverse range of security challenges and best practices. The selection criteria required participants to have direct experience or responsibility in managing data security risks, regulatory compliance, or cybersecurity strategy within their organisations.

A structured survey method was used to collect responses, ensuring that all data gathered was quantifiable and suitable for statistical analysis. The study involved 229 respondents, providing a sufficiently large sample for valid and generalizable insights. By focusing on key decision-makers and personnel with expertise in cybersecurity, the research ensures reliable and high-quality data to analyse trends, risks, and gaps in data security protocols across social service agencies in Singapore.

3.12 Instrumentation

The instrumentation for this study consists of a structured survey questionnaire designed to collect quantitative data on data security practices, challenges, and compliance levels within funded social service agencies in Singapore. The questionnaire is structured to ensure objective measurement of cybersecurity readiness and includes closed-ended questions and Likert-scale responses to facilitate statistical analysis. The survey is divided into multiple sections, covering key aspects such as data security policies, incident response strategies, regulatory compliance with Singapore's Personal Data Protection Act (PDPA), staff training on cybersecurity, and funding limitations affecting security implementations.

To ensure the instrument's reliability and validity, a pilot test was conducted with a small subset of respondents before full-scale distribution. This helped refine the questionnaire by identifying ambiguities and ensuring that all questions effectively captured the intended information. The finalized survey was then distributed to 229 respondents, including IT managers, data protection officers, administrative staff, and senior leadership teams, ensuring a diverse representation of perspectives from various social service agencies.

The survey responses were collected through digital platforms and email invitations, maintaining anonymity and compliance with ethical guidelines. The collected data was cleaned and preprocessed, and statistical tools such as SPSS or Python were used to perform descriptive and inferential analyses. A standardized and structured questionnaire ensures that the findings are quantifiable, reliable, and generalizable, contributing to evidence-based recommendations for enhancing data security protocols in social service agencies.

3.13 Data Collection Procedures

The data collection procedure for this study was designed to ensure a systematic and structured approach to gathering quantitative data on data security practices within funded social service agencies in Singapore. The primary data was collected through a structured questionnaire targeting 229 respondents, including IT managers, data protection officers, administrative staff, and senior leadership teams from various government-funded, private, and non-profit agencies. These participants were selected based on their involvement in cybersecurity implementation, regulatory compliance, and organisational decision-making.

The survey instrument was designed with closed-ended and Likert-scale questions to measure participants' perceptions, security practices, compliance with Singapore's Personal Data

Protection Act (PDPA), funding constraints, staff training on cybersecurity, and incident response strategies. The survey was pre-tested through a pilot study involving a small subset of participants to refine the questionnaire and ensure clarity, relevance, and reliability of responses. After finalizing the survey, invitations were emailed to participants containing a secure online survey link, ensuring ease of participation while maintaining confidentiality.

To maximize participation, follow-up reminders were sent, and participants were assured anonymity and data confidentiality in compliance with ethical research standards and PDPA regulations. The collected responses were systematically checked for completeness, cleaned to remove inconsistencies, and validated before analysis. Exploratory Data Analysis (EDA) was conducted to identify patterns, missing values, and any anomalies in the dataset. The final dataset was analysed using statistical tool such as Python, applying descriptive statistics to summarize key findings and inferential tests such as Chi-Square analysis, ANOVA, and Pearson correlation tests to examine relationships between variables.

By employing a rigorous and structured data collection procedure, this study ensures high data reliability and validity, providing empirical insights into the effectiveness of data security protocols, compliance challenges, and areas for improvement within Singapore's social service agencies.

3.14 Data Analysis

The data analysis conducted in this study utilised a quantitative methodology, thereby ensuring statistical rigor and empirical validity in the assessment of data security protocols within funded social service agencies in Singapore. Following the collection of survey responses from 229 participants, comprising IT managers, data protection officers, administrative staff, and leadership teams, the data underwent a systematic cleaning process. This process entailed checking for missing values, eliminating inconsistencies, renaming variables for clarity, and standardizing responses to preserve the integrity and accuracy of the dataset.

The analysis was conducted including Python, facilitating a systematic examination of the relationships, patterns, and trends within the collected data. Initially, descriptive statistics, such as frequency distributions, mean, standard deviation, and percentage analysis, were employed to summarize key findings pertaining to cybersecurity policies, compliance with Singapore's Personal Data Protection Act (PDPA), funding limitations, incident response strategies, and the effectiveness of employee training.

Inferential statistical analyses were performed to identify statistically significant relationships. Chi-Square analysis was employed to determine associations between categorical variables, such as the relationship between agency type (government-funded, private, non-profit) and cybersecurity challenges. ANOVA (Analysis of Variance) was utilized to compare mean differences across multiple groups, such as the impact of varying levels of funding on cybersecurity readiness and compliance. Furthermore, Pearson correlation tests were conducted to assess the strength and direction of relationships between continuous variables, such as the effect of regular staff training on the reduction of data breaches.

Exploratory data analysis (EDA) techniques were employed to discern trends, anomalies, and patterns within the dataset, thereby offering deeper insights into the primary challenges faced by social service agencies in implementing robust data security measures. The results of these statistical analyses were subsequently interpreted in alignment with the study's objectives, ensuring that the findings were both data-driven and generalizable. By adopting a rigorous quantitative data analysis approach, this study furnishes empirical evidence regarding the effectiveness of data security protocols, compliance challenges, and areas necessitating improvement within Singapore's social service sector. The findings contribute to evidence-based recommendations, enabling policymakers and agency leaders to formulate more effective cybersecurity strategies and funding frameworks to enhance data protection measures.

Objective 3 Regression Model

Model equation:

Effectiveness of data security protocols=β0+β1(Staff receives regular training)+β2 (Training reduces breaches)+β3(Training frequency)+β4(Cybersecurity awareness culture)

Where:

β0 = Intercept = 1.40

β1 = Coefficient for "Staff receives regular training on cybersecurity and data protection" = -0.1568

β2 = Coefficient for "Training has reduced data breaches due to human error" = 0.4247

β3 = Coefficient for "Training programs are frequent enough to keep staff informed" = 0.0848

β4 = Coefficient for "Our agency has a strong cybersecurity awareness culture" = 0.3048

Objective 4 Regression Model

Regression Model:

Data Security Effectiveness=β0+β1× Collaboration

Where:

β0 is the intercept = 4.25

β1 is the coefficient for collaboration = 0.56

Result:

```
{'Intercept': 4.246724890829694, 'Coefficient': 0.5606450186296134, 'R-squared':
0.5659464947873646}
```

Objective 5 Regression Model

Model Equation:

Data Security Challenge=1.2191+0.6569×Compliance Measures

Where:

Intercept: 1.2191 represents the predicted data security challenge when the compliance measures score is zero.

Coefficient for Compliance Measures: 0.6569 means that for each unit increase in compliance measures, the data security challenge score increases by 0.6569 units.

3.15 Research Design Limitations

The limitations of the research design in this study primarily arise from the scope, sampling constraints, and methodological boundaries inherent in employing a quantitative approach to the analysis of data security protocols within funded social service agencies in Singapore. A significant limitation is the exclusive use of structured surveys as the data collection method, which confines the study to predefined response options and fails to capture the in-depth contextual insights that qualitative methods might offer. While the survey ensures statistical validity, the lack of open-ended responses may restrict a comprehensive understanding of organisational challenges and cybersecurity decision-making processes.

Another limitation of this study is the constraints associated with the sampling methodology, as it employs purposive sampling aimed at IT managers, data protection officers, administrative staff, and leadership teams. While this approach ensures the inclusion of responses from pertinent decision-makers, it may inadvertently exclude frontline employees or smaller agencies with less developed cybersecurity infrastructures, thereby potentially introducing selection bias. Additionally, the cross-sectional design of the study, wherein data is collected at a single point in time, restricts the ability to observe longitudinal trends in the adoption and enhancement of cybersecurity policies over time.

The study is geographically confined to Singapore, rendering the findings highly specific to the regulatory framework established by the Personal Data Protection Act (PDPA) and the local funding models. This specificity constrains the generalisability of the results to social service agencies operating in different legal and economic contexts. Furthermore, the research presupposes that participants provide honest self-reporting; however, there exists the potential for social desirability bias, wherein respondents may exaggerate compliance levels or the effectiveness of their cybersecurity measures.

Inferential statistical tests, including Chi-Square analysis, ANOVA, and Pearson correlation, offer substantial insights into the relationships among cybersecurity practices, funding levels, and effective training. Nevertheless, these tests do not establish causality. The study identifies correlations between variables but cannot confirm direct causal effects, necessitating further research employing experimental or longitudinal designs to validate cause-and-effect relationships. Despite these limitations, the study maintains statistical rigor, empirical validity, and relevance to its objectives, providing actionable insights for enhancing data security protocols in Singapore's funded social service agencies. Future research could address these limitations by incorporating longitudinal studies, expanding the sample to include smaller agencies, and employing alternative statistical models to enhance predictive accuracy.

3.16 Research Data Reliability

The study deems the 229 respondents reliable, primarily due to the methodological strategies employed to ensure data quality and representativeness. These strategies include:
Sufficient Sample Size: The survey was administered to 229 respondents to ensure statistical reliability and to provide a sufficiently large sample for valid and generalizable insights.

Purposive Sampling: A purposive sampling method was utilised to select participants directly involved in data security management, compliance, and decision-making within funded social service agencies in Singapore. This approach ensures that the insights gathered are derived from relevant key personnel, such as IT managers, data protection officers, administrative staff, board members, and senior leadership teams.

Diverse Representation: The sample encompasses organisations of diverse sizes, funding structures, and levels of cybersecurity maturity, thereby facilitating the creation of a comprehensive and generalisable dataset for analysis. This structured sampling is designed to accurately represent real-world challenges and practices across various types of agencies.

Structured Survey Instrument: Employing a structured survey questionnaire that incorporates closed-ended and Likert-scale questions ensures an objective assessment of cybersecurity readiness. This approach facilitates statistical analysis, thereby enhancing the reliability and validity of the findings.

Pilot Testing: The survey instrument underwent a preliminary evaluation with a select group of respondents to refine the questionnaire, identify ambiguities, and ensure that the questions effectively captured the intended information, thereby enhancing its reliability and validity.

Data Cleaning and Preprocessing: The collected data underwent a systematic process of cleaning and preprocessing to address missing values, eliminate inconsistencies, and standardize responses, thereby ensuring the integrity and accuracy of the dataset.

While the study acknowledges potential limitations, such as the reliance on self-reported data and geographical constraints, the rigorous methodology employed seeks to ensure the reliability and validity of the findings derived from the collected responses.

3.17 Conclusion

The conclusion of this study underscores the imperative to enhance data security protocols within funded social service agencies in Singapore. It emphasizes the significance of regulatory compliance, cybersecurity training, adequate funding, and technological adoption in safeguarding sensitive information. The study's quantitative analysis offers empirical insights into the challenges encountered by social service agencies, such as resource constraints, regulatory burdens, and deficiencies in cybersecurity preparedness. The findings confirm that agencies with higher funding and regular cybersecurity training programs exhibit more robust data protection measures, whereas those with limited resources face difficulties in implementing and complying with Singapore's Personal Data Protection Act (PDPA). The statistical analysis, including Chi-Square, ANOVA, and Pearson correlation tests, reveals significant relationships between funding levels, staff training, regulatory compliance, and cybersecurity effectiveness, highlighting the necessity of a structured approach to data security management. Although most agencies acknowledge the importance of incident response strategies and preventive measures, the study identifies variations in implementation effectiveness across different agency types, particularly among smaller organisations with lower cybersecurity budgets.

Despite its limitations, such as sampling constraints and the use of cross-sectional data collection, this study offers evidence-based recommendations for enhancing data security frameworks, increasing investment in cybersecurity training, and promoting inter-agency collaboration to mitigate cyber threats and data breaches. Policymakers, agency leaders, and cybersecurity professionals should utilize these findings to formulate targeted strategies aimed at bolstering data security resilience within Singapore's social service sector. Future research should investigate longitudinal trends in cybersecurity adoption, employ predictive modeling for risk assessment, and broaden the sample to include smaller agencies to enhance the generalizability of the findings. By addressing identified gaps and implementing robust data security measures, social service agencies can more effectively protect sensitive data, ensure regulatory compliance, and maintain public trust in an increasingly digitalized service environment.

CHAPTER IV:
RESULTS

4.1 Introduction

The graphs presented in the data analysis document offer a comprehensive visualization of key cybersecurity challenges, trends, and organisational practices among funded social service agencies in Singapore. These graphs depict demographic distributions, cybersecurity preparedness, compliance with data protection regulations, funding constraints, and the impact of training programs on security effectiveness. Visual representations facilitate the identification of patterns, correlations, and differences across various agency types, including private, non-profit, and government-funded organisations. Key insights from the graphs reveal the predominance of private agencies in cybersecurity engagement, the variation in security protocols across agency sizes, and the widespread implementation of data breach response plans. Furthermore, graphs illustrate cybersecurity budgets, funding sources, and staff training frequency underscore disparities in resource allocation and workforce development efforts. Statistical test results, such as Chi-Square and ANOVA, further substantiate significant differences in cybersecurity challenges, funding constraints, and regulatory compliance issues among agencies. Overall, the visual analysis enhances the understanding of how factors such as funding, training, and regulatory adherence influence an agency's cybersecurity resilience. These graphical representations provide data-driven insights for decision-makers to refine security strategies, allocate resources effectively, and develop targeted interventions to strengthen cybersecurity frameworks within the social service sector.

4.2 Demographic Details

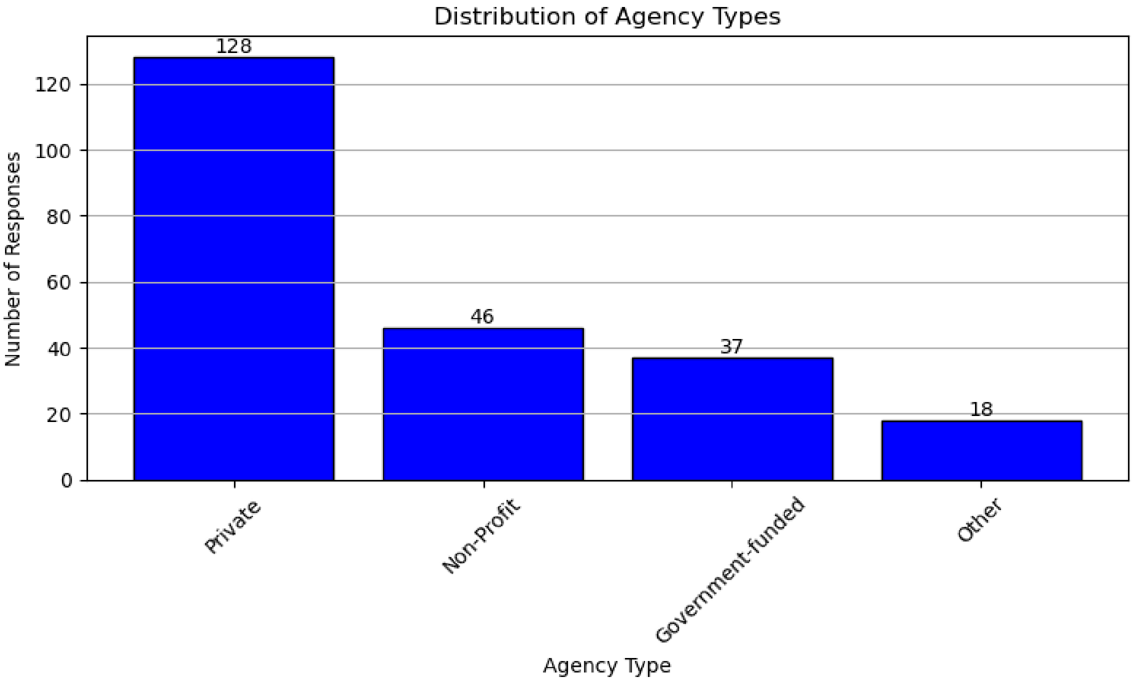

Figure 2 Distribution of Agency Type

Private Agencies:

The highest number of responses (over 120) come from Private agencies.

This suggests strong participation and engagement from private organisations regarding the subject matter.

Non-Profit Agencies:

The second-highest number of responses were from Non-Profit agencies.

Indicates a notable interest from non-profits, likely due to their reliance on data for donor management and beneficiary support.

Government-Funded Agencies:

Ranked third in the number of responses, reflecting a moderate level of participation.

Likely tied to the structured requirements these agencies adhere to regarding data protection.

Other Agencies:

The lowest number of responses was from the Other category, suggesting minimal representation from entities outside the main three types.

Interpretation

The distribution of responses based on agency type shows that private agencies had the highest participation in the survey, with over 120 responses. This indicates that private agencies are highly engaged with the topic of data security, possibly because they manage large volumes of client information and are aware of related risks.

Non-profit agencies made up the second largest group of respondents. Their strong interest may be linked to their reliance on data for managing donor relationships and supporting their beneficiaries, as highlighted in the literature review of the proposal.

Government-funded agencies had a moderate level of participation. This may reflect their existing obligations to comply with regulatory frameworks like the Personal Data Protection Act (PDPA), which could influence their level of awareness and interest in data protection issues.

Agencies classified under "Other" had the lowest response rate. This suggests that organisations outside the main categories (private, non-profit, and government-funded) have less representation in the data, possibly due to limited relevance or smaller size.

This pattern of responses provides insight into which agency types are more actively engaged in addressing data security concerns and reflects the varying degrees of attention this issue receives across different sectors.

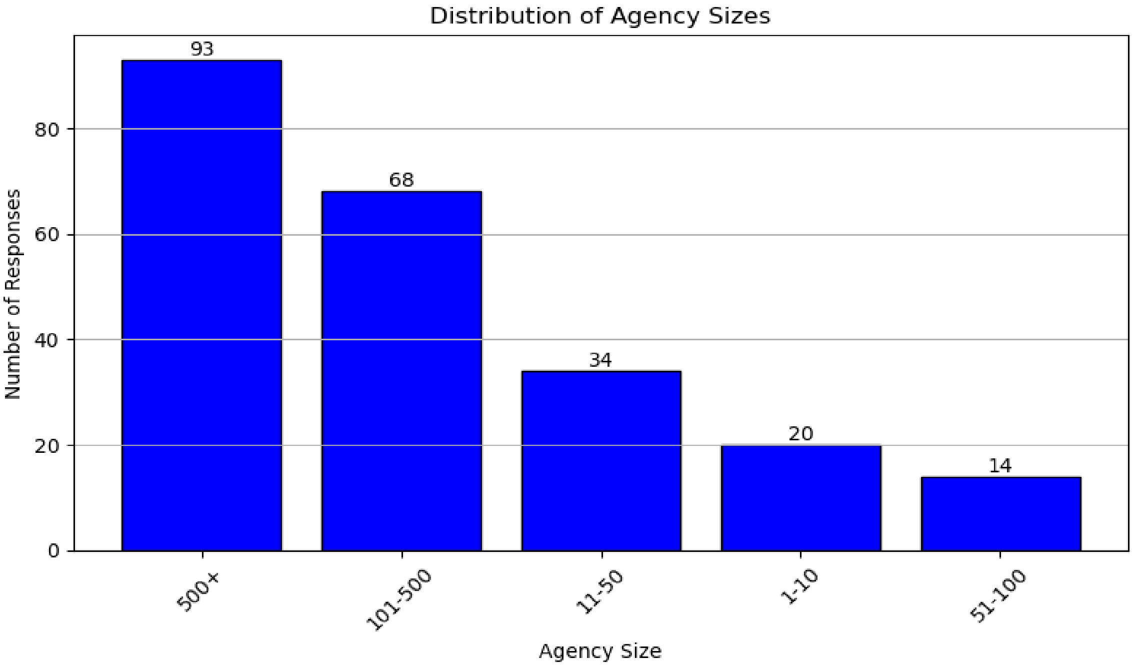

Figure 3 Distribution of Agency Size

Largest Group: Agencies with 500+ employees have the highest number of responses, indicating their significant participation in the survey.

Second-Largest Group: Agencies with 101-500 employees are the second-most represented, showing considerable engagement as well.

Smaller Agencies: Agencies with 11-50 employees and 1-10 employees have fewer responses compared to the larger agencies.

Least Represented: Agencies with 51-100 employees have the lowest participation among all groups.

Interpretation:

The distribution of responses based on agency size reveals that larger social service agencies in Singapore are more actively represented in this study. Agencies with over 500 employees contributed the highest number of responses, suggesting that these organisations may have more established data management structures and a greater interest in cybersecurity matters.

Agencies with 101 to 500 employees also showed substantial participation, further indicating that medium-to-large agencies are highly engaged in addressing data security concerns. In contrast, smaller agencies, particularly those with 11 to 50 and 1 to 10 employees, had comparatively lower response rates. Notably, the lowest participation came from agencies with 51 to 100 employees. This trend may reflect the resource and staffing limitations of smaller agencies, which can influence their ability to prioritise or engage with data security initiatives. These findings align with the research's focus on understanding how agency size impacts the implementation of data security protocols in resource-constrained environments.

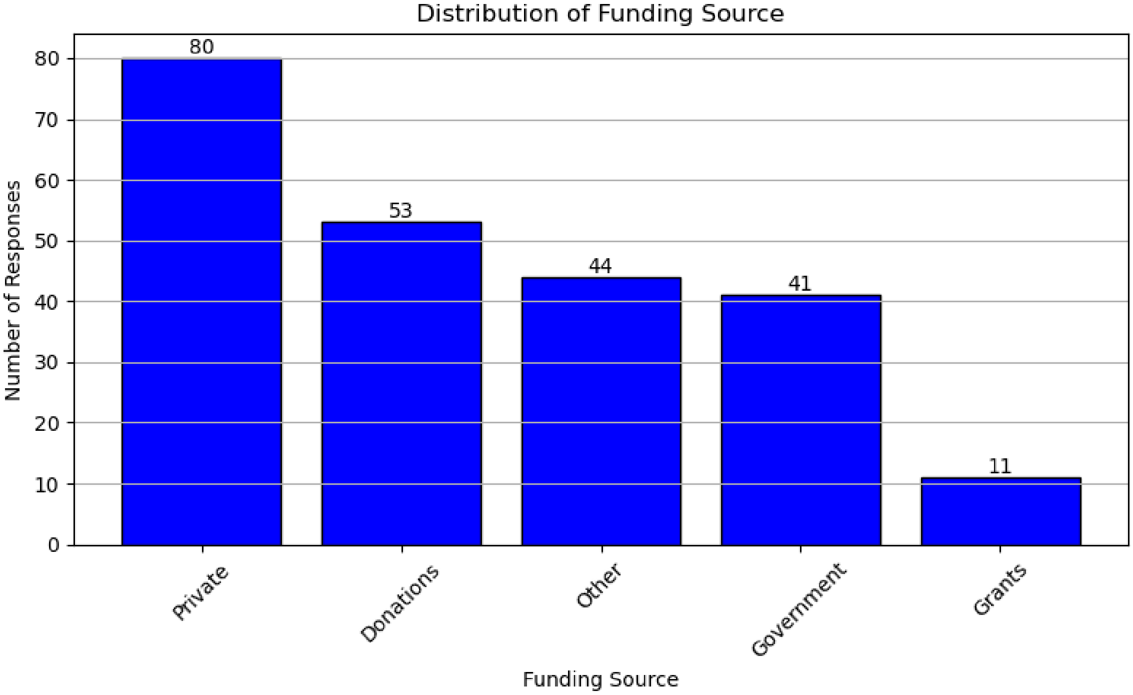

Figure 4 Distribution of Funding Source

Private Funding Dominates:

Agencies primarily funded by Private sources have the highest number of responses, significantly outpacing other funding sources.

Donations as a Key Contributor:

Agencies receiving funding from Donations represent the second-largest group, indicating substantial reliance on this source.

Moderate Representation:

Agencies with funding from Government and Other sources have a moderate number of responses, reflecting a balanced participation compared to the top two categories.

Grants as the Least Represented:

Agencies funded by Grants show the lowest participation, suggesting that this funding source is less common among the respondents or less significant in terms of engagement.

Key Insights:

The dominance of private funding highlights the role of private capital in sustaining many agencies.

The significant representation of donations emphasizes the importance of public or philanthropic contributions.

Lower responses from grant-funded agencies might suggest limited access to or reliance on grants as a primary funding source among surveyed agencies.

Interpretation:

The data indicates that private funding constitutes the most common source of financial support for the surveyed social service agencies. This dominance suggests a strong dependence on private entities, which may include corporate sponsorships, foundations, or personal contributions. Donations emerged as the second most frequently reported funding source, underscoring the nonprofit sector's reliance on public generosity to sustain operations. In contrast, agencies receiving support from government sources and other unspecified categories show moderate representation, suggesting that while public sector support exists, it is not the primary financial pillar for most agencies. Notably, grants were reported as the least common funding source among respondents. This may reflect limited access to or competition for grant-based financing, or possible administrative challenges associated with grant applications and compliance.

These findings highlight the diversity of funding streams within the sector but also point to potential vulnerabilities, particularly in agencies heavily reliant on less stable sources such as private contributions and donations. Given the financial constraints identified in the literature review, these funding patterns could directly impact an agency's capacity to invest in and maintain robust data security protocols.

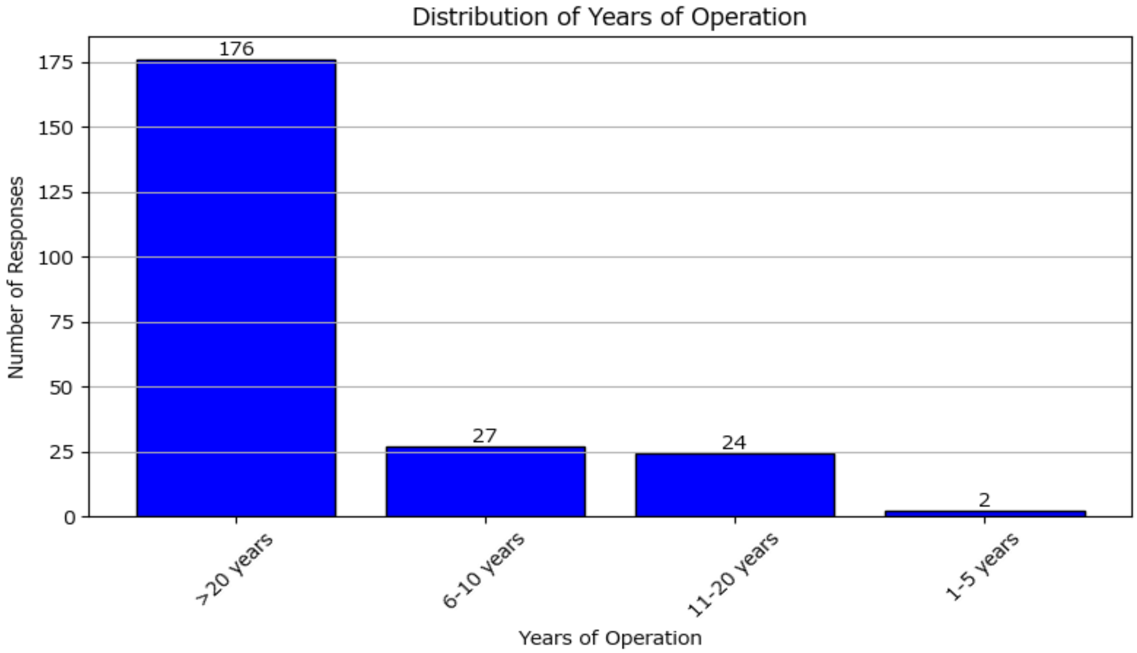

Figure 5 Distribution of Years Of Operation

Dominance of Long-Established Agencies:

Agencies operating for more than 20 years have the highest number of responses by a significant margin, suggesting a strong presence of well-established organisations in the survey.

Moderate Representation:

Agencies with 6-10 years and 11-20 years of operation have a moderate number of responses, reflecting a fair level of participation from mid-aged organisations.

Low Representation of Newer Agencies:

Agencies operating for 1-5 years have the fewest responses, indicating limited engagement or fewer such agencies in the dataset.

Key Insight:

The graph shows that most responses come from agencies with a long history of operation, indicating that well-established organisations are more engaged or better represented in this survey. There is relatively lower participation from newer organisations, which might suggest a need to focus on their inclusion in future studies.

Interpretation:

The distribution of responses to the question on years of operation indicates that the majority of participating social service agencies have been in operation for more than 20 years. This suggests that the sample is largely composed of long-established organisations, which may reflect a higher level of institutional stability and experience in the sector. Agencies that have been operating for 6 to 20 years are moderately represented, pointing to a fair inclusion of mid-aged organisations. In contrast, agencies operating for less than 5 years are underrepresented, which may be due to either a smaller number of such agencies in the sector or lower participation in the survey. The predominance of responses from older agencies could influence the findings, as these organisations may have more developed data security protocols compared to newer ones with limited resources and infrastructure.

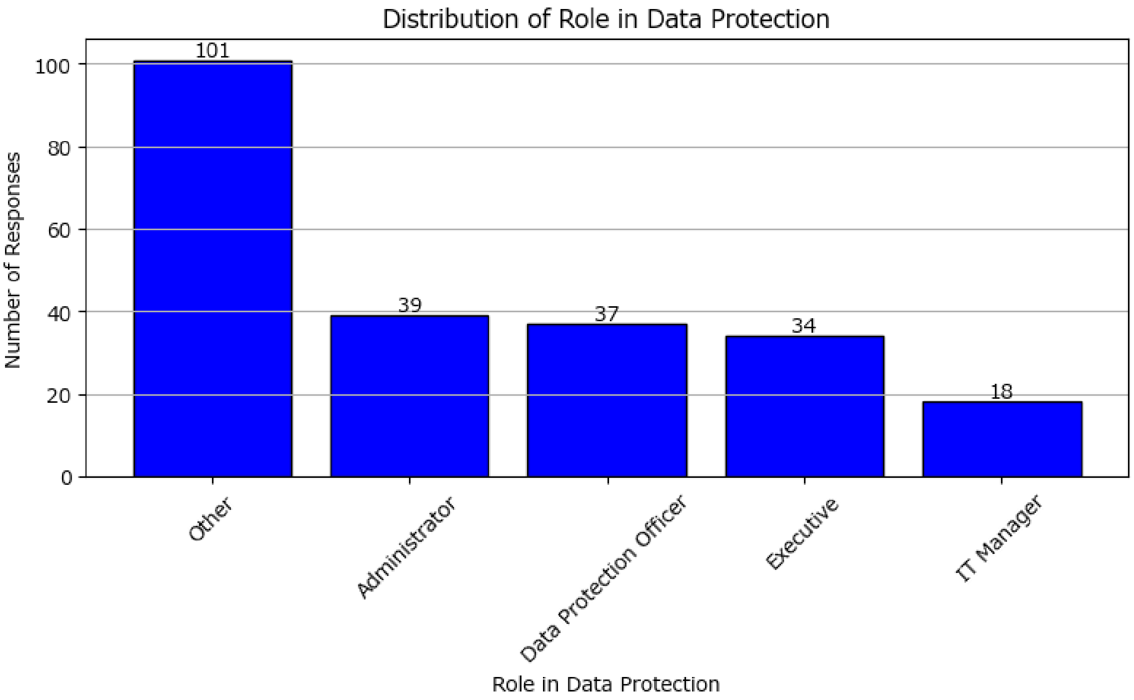

Figure 6 Distribution of Role in Data Protection

Dominant Category (Other):

The majority of responses fall under the "Other" category, suggesting a wide variety of roles not explicitly listed in the survey.

Administrator, Data Protection Officer, and Executive:

These three roles are moderately represented, each having a similar number of responses. This indicates that these roles are fairly common among respondents involved in data protection.

IT Manager:

The IT Manager role has the fewest responses, highlighting that this specific role is less prevalent or less actively engaged in data protection discussions in the dataset.

Key Insight:

The graph suggests that data protection responsibilities are distributed across a broad spectrum of roles, with many respondents identifying as part of "Other" categories. While formal roles like Administrator and Data Protection Officer are present, the diversity in roles indicates that data protection is a shared responsibility in many organisations.

Interpretation:

The distribution of responses to the question regarding the respondents' roles in data protection reveals key insights into the staffing structure of data security responsibilities within funded social service agencies in Singapore. Notably, the "Other" category constitutes the largest group, suggesting that many individuals involved in data protection occupy roles not formally recognised or designated as part of typical data protection frameworks. This reflects the fluid or ad-hoc nature of cybersecurity responsibilities in these agencies, likely due to limited staffing or overlapping job functions, as noted in the research proposal.

Moderate representation among Administrators, Data Protection Officers, and Executives indicates that these positions play a consistent but varied role in data protection practices. Their involvement aligns with the study’s emphasis on the importance of leadership and organisational commitment to cybersecurity.

Conversely, the role of IT Managers appears underrepresented, which may point to a scarcity of dedicated IT professionals in the sector—a finding that supports the research’s assertion that many social service agencies lack technical expertise and sufficient cybersecurity infrastructure. This gap reinforces the need for capacity building and clearly defined roles within agencies to effectively implement and manage data security protocols.

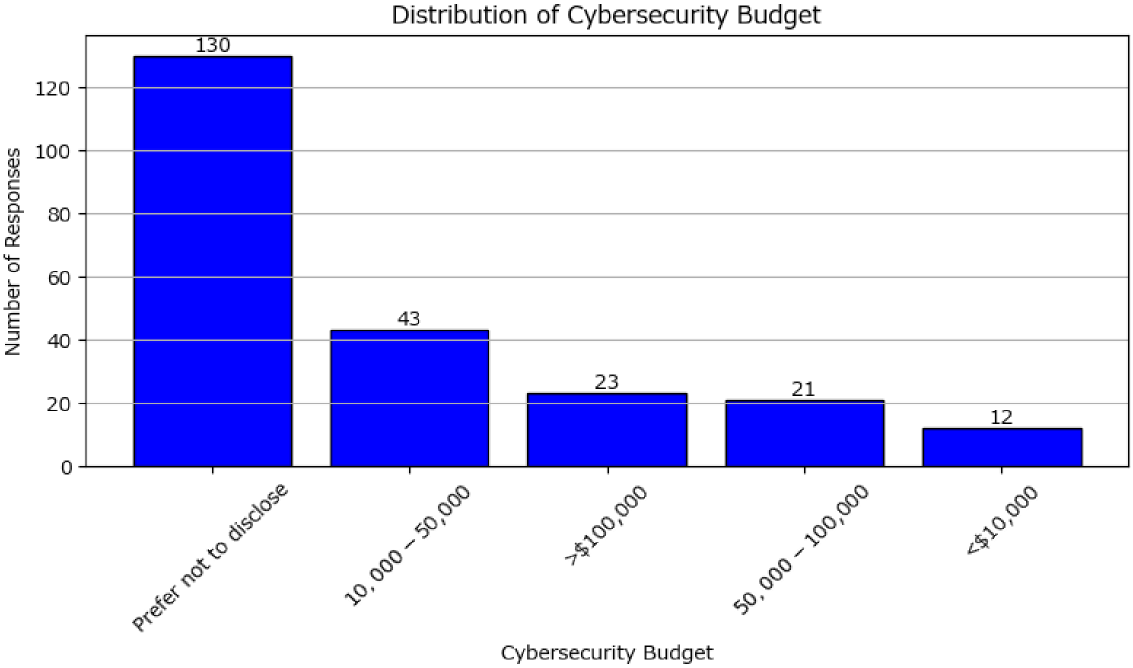

Figure 7 Distribution of Cyber-security Budget

Highest Category - "Prefer not to disclose":

The majority of respondents chose not to disclose their cybersecurity budget, making this the largest category.

Common Budget Range:

Among disclosed budgets, the most common range is $10,000–$50,000, indicating that many organisations allocate a moderate amount of resources for cybersecurity.

Higher Budgets:

Fewer organisations report budgets above $50,000, with even fewer exceeding $100,000, suggesting that large cybersecurity investments are less common.

Lowest Category - <$10,000:

Very few organisations allocate less than $10,000, implying that minimal budgets for cybersecurity are uncommon.

Key Insight:

This graph highlights a tendency for organisations to withhold information about their cybersecurity budgets. For those who disclose, the most frequent allocation is in the moderate range ($10,000–$50,000), while higher budgets are relatively rare. This could indicate resource constraints or prioritization challenges in cyber security funding.

Interpretation:

The analysis of responses to the question on annual cybersecurity budgets reveals several key patterns. Most notably, the largest group of respondents selected "Prefer not to disclose," indicating a general reluctance among social service agencies to share financial information related to cybersecurity. This may reflect concerns about confidentiality or a lack of transparency in budget reporting.

Among those who did report their budgets, the majority indicated an annual allocation in the range of $10,000 to $50,000. This suggests that while agencies do recognize the importance of cybersecurity, their investments remain modest—likely constrained by limited funding, as highlighted in the literature review.

Only a small proportion of agencies reported budgets exceeding $50,000, and even fewer allocated more than $100,000. This indicates that large-scale investment in cybersecurity remains rare among funded social service agencies in Singapore. Conversely, very few agencies reported budgets below $10,000, suggesting that extremely low investment levels are uncommon, and that most agencies are making at least some effort to secure their digital infrastructure.

These findings reinforce the challenges discussed in the research proposal, particularly the impact of financial limitations on the ability of social service agencies to implement advanced data security measures. The moderate to low levels of cybersecurity funding reflect the broader issue of resource constraints in the nonprofit sector.

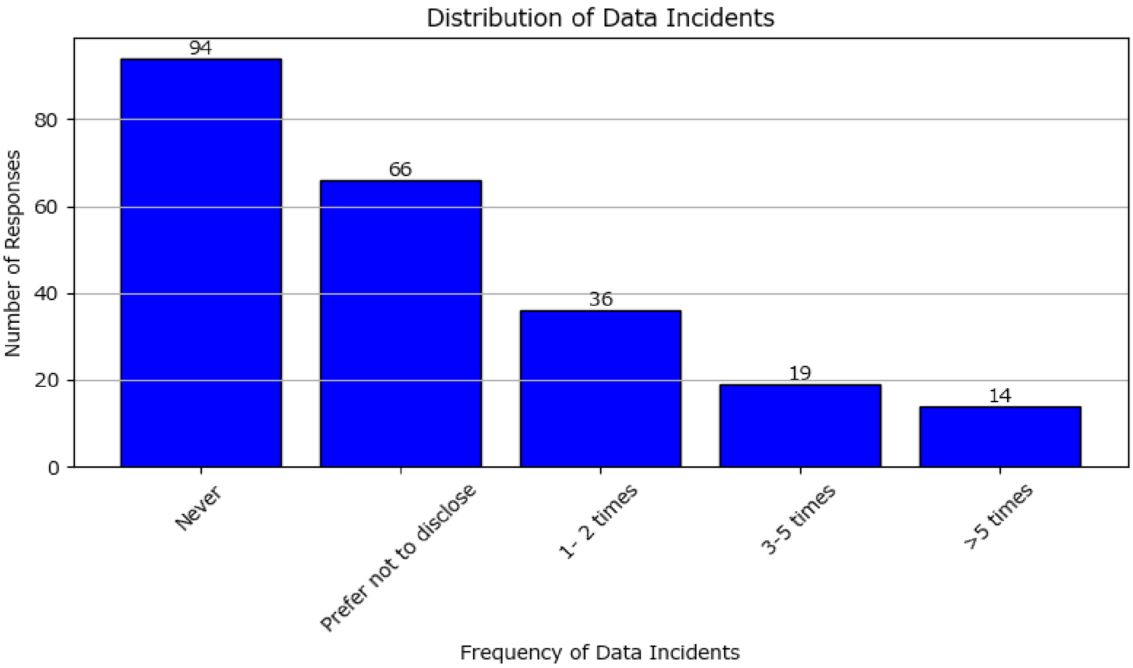

Figure 8 Distribution of Data Incidents

No Data Incidents (Never):

The largest number of responses indicate that these organisations have never experienced a data incident, reflecting either effective data security measures or a lack of awareness/reporting.

Prefer Not to Disclose:

A significant portion of respondents chose not to disclose their experience with data incidents, which limits insight into the true scale of the issue.

1–2 Times:

A considerable number of organisations reported experiencing 1–2 data incidents, suggesting that minor incidents are relatively common.

3–5 Times and More Than 5 Times:

Fewer organisations reported experiencing 3–5 data incidents or more than 5 data incidents, indicating that repeated breaches are less frequent but still occur.

Key Insight:

The graph highlights that while many organisations claim they have never experienced a data incident, a notable portion either avoids disclosure or reports minor breaches. This may suggest a mix of effective security practices and hesitancy in sharing sensitive information about data incidents. The lower numbers for repeated breaches reflect either improved resilience after initial incidents or underreporting.

Interpretation:

The responses to Question 7 reveal important insights into the frequency of data security incidents among funded social service agencies in Singapore. The largest proportion of respondents indicated that their agencies had not experienced any data security incidents in the past year. This could suggest that some agencies have implemented effective data protection measures. However, it may also reflect a possible lack of awareness or underreporting of incidents, particularly in agencies without robust incident detection systems or clear reporting procedures.

A notable number of participants selected "Prefer Not to Disclose," which presents a limitation in understanding the actual scope of data security issues within the sector. This reluctance to report may stem from concerns about reputational risk, a lack of internal tracking systems, or uncertainty about how to classify data incidents.

Meanwhile, a considerable share of respondents reported experiencing 1–2 data security incidents over the past year. This indicates that while major breaches may be rare, smaller or less severe incidents are relatively common and highlight potential vulnerabilities in current data security practices.

Fewer agencies reported higher frequencies of data breaches—specifically, 3–5 times or more than 5 times—which suggests that while repeated breaches are less widespread, they are still a concern for some organisations. These findings underscore the importance of strengthening incident detection, staff training, and reporting mechanisms to ensure a clearer understanding of the security landscape across social service agencies.

Overall Summary of bar graphs of Demographic details:

The bar graphs provide a comprehensive overview of the organisational demographics and their relationship with cybersecurity efforts. Private agencies dominate the responses, followed by non-profits, indicating their significant engagement in data security, while government-funded and smaller agencies are underrepresented. Larger agencies with 500+ employees lead participation, reflecting their higher capacity and investment in cybersecurity, while smaller agencies show limited involvement. Private funding is the primary financial source, followed by donations, emphasizing the reliance on private capital and public contributions, whereas grants and government funding remain less common. Most responding organisations have been in operation for over 20 years, showcasing the maturity of their frameworks, while newer agencies are less represented. In terms of roles, data protection responsibilities are widely distributed, with many respondents falling under the "Other" category, highlighting diverse but undefined leadership in cybersecurity. Regarding budgets, most organisations allocate a moderate amount ($10,000–$50,000) to cybersecurity, with transparency around funding still limited. Finally, while many organisations report no data incidents, some admit to 1-2 breaches, with fewer cases of repeated breaches. These findings underline the dominance of larger, well-established, privately funded agencies in the dataset and highlight gaps in engagement, resources, and incident reporting among smaller or less mature organisations.

4.3 Data Security Protocols in Funded Social Service Agencies

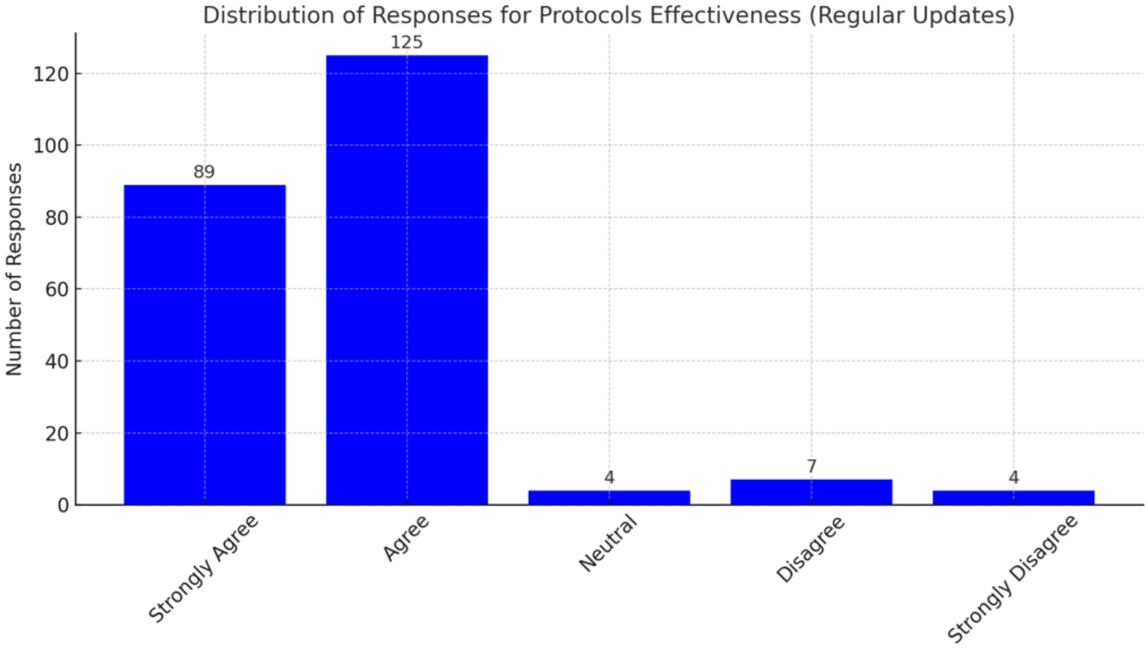

Figure 9 Distribution of Data Security Protocols

Positive Responses (Strongly Agree and Agree):

The majority of respondents either Agree (125 responses) or Strongly Agree (89 responses) that data security protocols are effective and regularly updated. This highlights a strong consensus about the effectiveness of these protocols among most participants.

Neutral Responses:

A small number of respondents (4 responses) are neutral, indicating a lack of strong opinion or uncertainty about the effectiveness and updates of these protocols.

Negative Responses (Disagree and Strongly Disagree):

Only a few respondents reported Disagree (7 responses) or Strongly Disagree (4 responses), suggesting minimal dissatisfaction or skepticism regarding data security protocols.

Key Insight:

The graph demonstrates overwhelming agreement about the effectiveness and regular updates of data security protocols, with very few expressing disagreement. This indicates a high level of confidence among respondents in the current data security measures in place. However, the small portion of neutral or negative responses suggests there may still be room for improvement or communication regarding these protocols for some organisations.

Interpretation:

The responses to the question "Our data security protocols effectively protect sensitive information" demonstrate a generally positive perception of the effectiveness of the data security measures in place. A significant majority of respondents (125 agreeing and 89 strongly agreeing) reported confidence in the ability of these protocols to safeguard sensitive information, indicating that most participants believe the protocols are both effective and regularly updated.

However, a small portion of respondents (4 neutral) expressed uncertainty, suggesting that while they do not strongly agree or disagree, there may be some ambiguity regarding the protocols' effectiveness or their regular updates. Additionally, only a few participants (7 disagreeing and 4 strongly disagreeing) expressed dissatisfaction, highlighting that the majority view the data security protocols favorably.

This indicates that, overall, funded social service agencies in Singapore are perceived to have effective data security protocols, with only minor concerns or uncertainties raised by a small fraction of respondents. This aligns with the broader aim of ensuring robust data security in these agencies, as discussed in the research proposal. The data also suggests that while protocols are largely effective, some improvements or clarifications may still be necessary, particularly for the small group of respondents who expressed doubts.

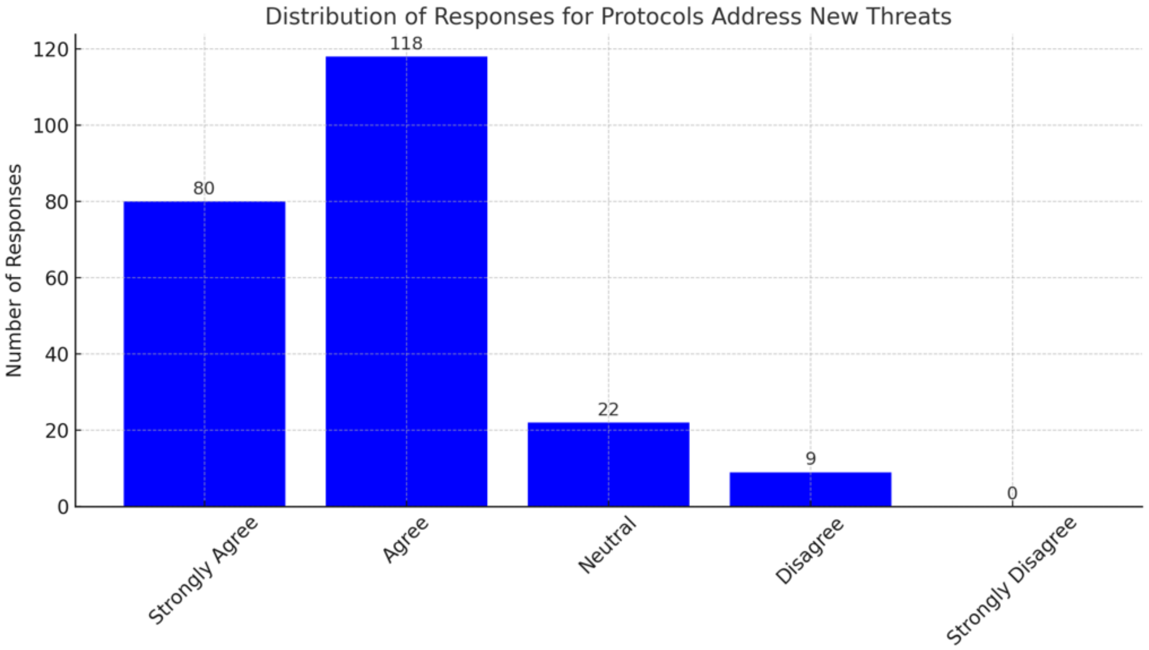

Figure 10 Distribution of Protocols Address New Threats

Positive Responses (Strongly Agree and Agree):

The majority of respondents either Agree (118 responses) or Strongly Agree (80 responses) that their data security protocols address new threats effectively. This reflects a high level of confidence in the adaptability of these protocols.

Neutral Responses:

A smaller group of respondents (22 responses) expressed a Neutral opinion, indicating some uncertainty or lack of strong perspective regarding the effectiveness of the protocols in addressing new threats.

Negative Responses (Disagree and Strongly Disagree):

Very few respondents Disagree (9 responses), and no one Strongly Disagrees, suggesting minimal dissatisfaction or skepticism about the protocols' ability to handle new threats.

Interpretation:

The responses to the question, "Our protocols can address new cybersecurity threats," indicate a generally positive assessment of the data security protocols employed by the social service agencies. A significant majority of respondents, comprising 118 individuals who "Agree" and 80 who "Strongly Agree," expressed confidence in the adaptability of these protocols to effectively counter emerging cybersecurity threats. This suggests that, overall, these agencies believe their current security measures are well-equipped to handle new risks.However, a smaller proportion of respondents, 22 individuals, remained neutral, implying some uncertainty or a lack of definitive opinion regarding the effectiveness of these protocols. This may reflect either a lack of familiarity with the protocols' performance or a hesitance in evaluating their adequacy in dealing with evolving threats.The negative responses were minimal, with only 9 respondents expressing disagreement and no respondents strongly disagreeing. This low level of dissatisfaction suggests that most agencies are relatively confident in their data security protocols' ability to adapt to new cybersecurity challenges.

Overall, the data suggests that while there may be some uncertainty among a small group of respondents, the majority of social service agencies feel that their protocols are capable of addressing emerging cybersecurity threats. This aligns with the research's aim to explore how funded agencies in Singapore are handling cybersecurity risks and indicates that these agencies have established relatively effective measures, despite some room for improvement.

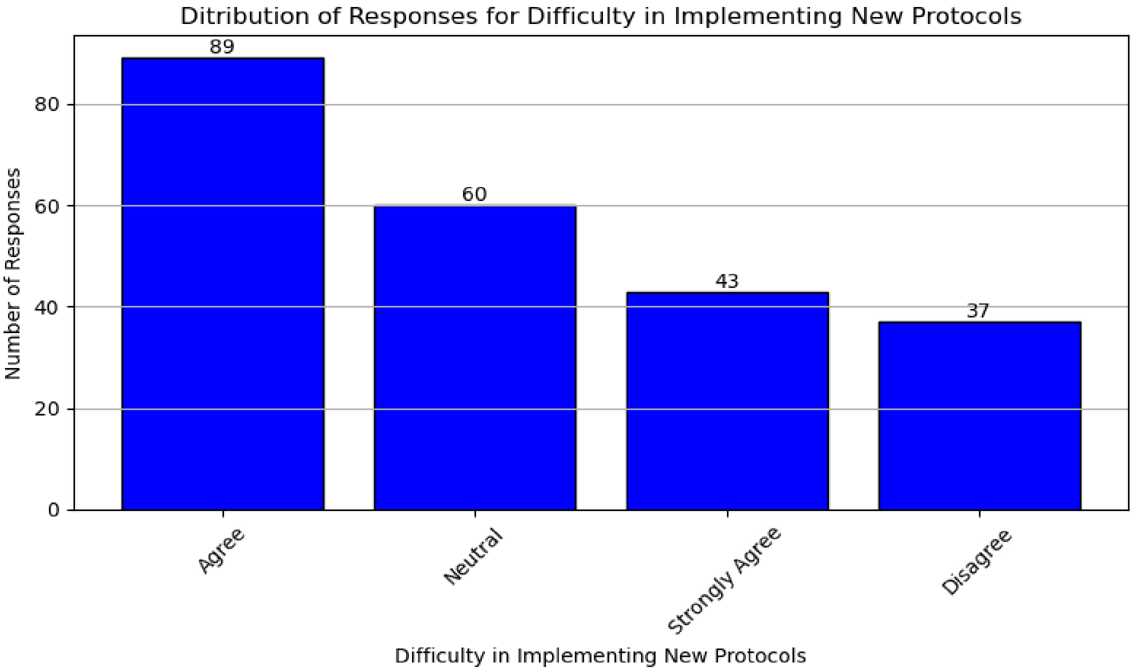

Figure 11 Distribution of Difficulty in Implementing New Protocols

Agreement on Difficulty:

A significant number of respondents Agree (89 responses) or Strongly Agree (43 responses) that implementing new protocols is difficult, indicating that many organisations find this process challenging.

Neutral Responses:

A moderate number of respondents (60 responses) are Neutral, suggesting some uncertainty or mixed experiences regarding the difficulty of implementing new protocols.

Disagreement on Difficulty:

A smaller group (37 responses) Disagree, and no respondents strongly disagree, implying that some organisations do not perceive implementing new protocols as a significant challenge.

Interpretation:

The bar graph reveals a notable consensus regarding the difficulty of implementing new security protocols in funded social service agencies. A substantial majority of respondents (89 agreeing and 43 strongly agreeing) indicate that these agencies face significant challenges in adopting new security protocols, primarily due to issues related to compatibility or staff-related concerns. This suggests that many organisations struggle with integrating new systems effectively within their existing infrastructure or overcoming internal staffing limitations, which aligns with the issues highlighted in the research proposal regarding resource constraints and technical expertise.

However, there is also a moderate proportion of respondents (60 individuals) who remain neutral on this issue, suggesting that while some organisations may have mixed experiences, others may not perceive the difficulty as strongly. This could reflect varying levels of preparedness or the nature of the specific protocols being implemented across different agencies.

A smaller group of respondents (37) disagrees with the notion that implementing new protocols is difficult, indicating that, for certain organisations, the process of updating or enhancing security measures might be perceived as more manageable. Importantly, there were no responses indicating strong disagreement, suggesting that even in these cases, there may still be underlying challenges.

In sum, the data suggests that implementing new security protocols in social service agencies is predominantly viewed as a complex and difficult task, primarily due to factors like system compatibility and staff-related barriers, which are central concerns discussed in the research proposal.

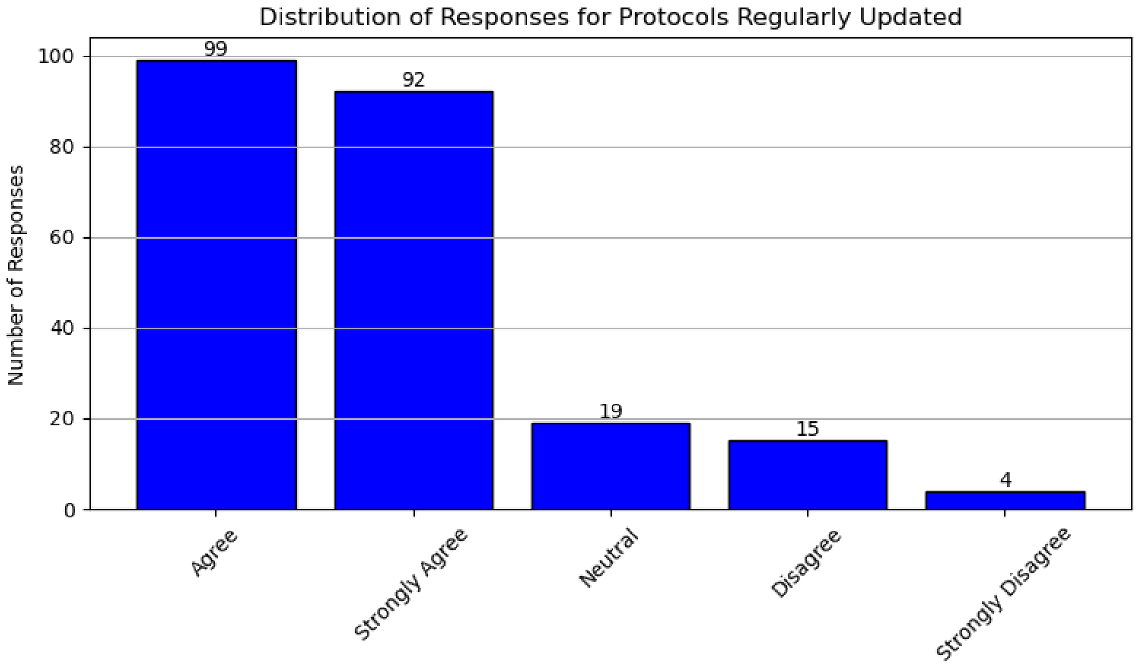

Figure 12 Distribution of Protocols Regularly Updated

Positive Responses:

A majority of respondents Agree (99 responses) or Strongly Agree (92 responses) that their data security protocols are regularly updated. This indicates widespread satisfaction with the frequency of updates.

Neutral Responses:

A smaller group (19 responses) provided a Neutral response, suggesting that some participants are unsure or indifferent about the regularity of updates.

Negative Responses:

A few respondents Disagree (15 responses) or Strongly Disagree (4 responses), reflecting a minority view that updates are not occurring regularly.

Interpretation:

The majority of respondents (99 in agreement and 92 in strong agreement) indicated that they regularly update their data security protocols to meet established standards. This suggests that most agencies believe they are effectively maintaining and improving their security measures in line with evolving requirements. The high level of positive responses indicates a widespread confidence among participants in their agencies' ability to stay current with data security practices.

However, a smaller group of respondents (19) provided a neutral response, indicating uncertainty or indifference about the frequency of protocol updates. This neutrality may reflect some lack of awareness or understanding of the processes involved in updating security protocols, or it could point to variations in how security updates are implemented across agencies.

A minority of respondents (15 disagreed and 4 strongly disagreed) expressed concerns, suggesting that these agencies may not be updating their security protocols as regularly as required. This indicates potential vulnerabilities or gaps in data security practices, which may leave these agencies more exposed to risks such as data breaches or cyberattacks.

Overall, the findings indicate that while a significant portion of social service agencies in Singapore are adhering to the expected standards for regular security protocol updates, there remains a need to address the concerns of the minority, particularly in terms of improving awareness, consistency, and compliance across all agencies.

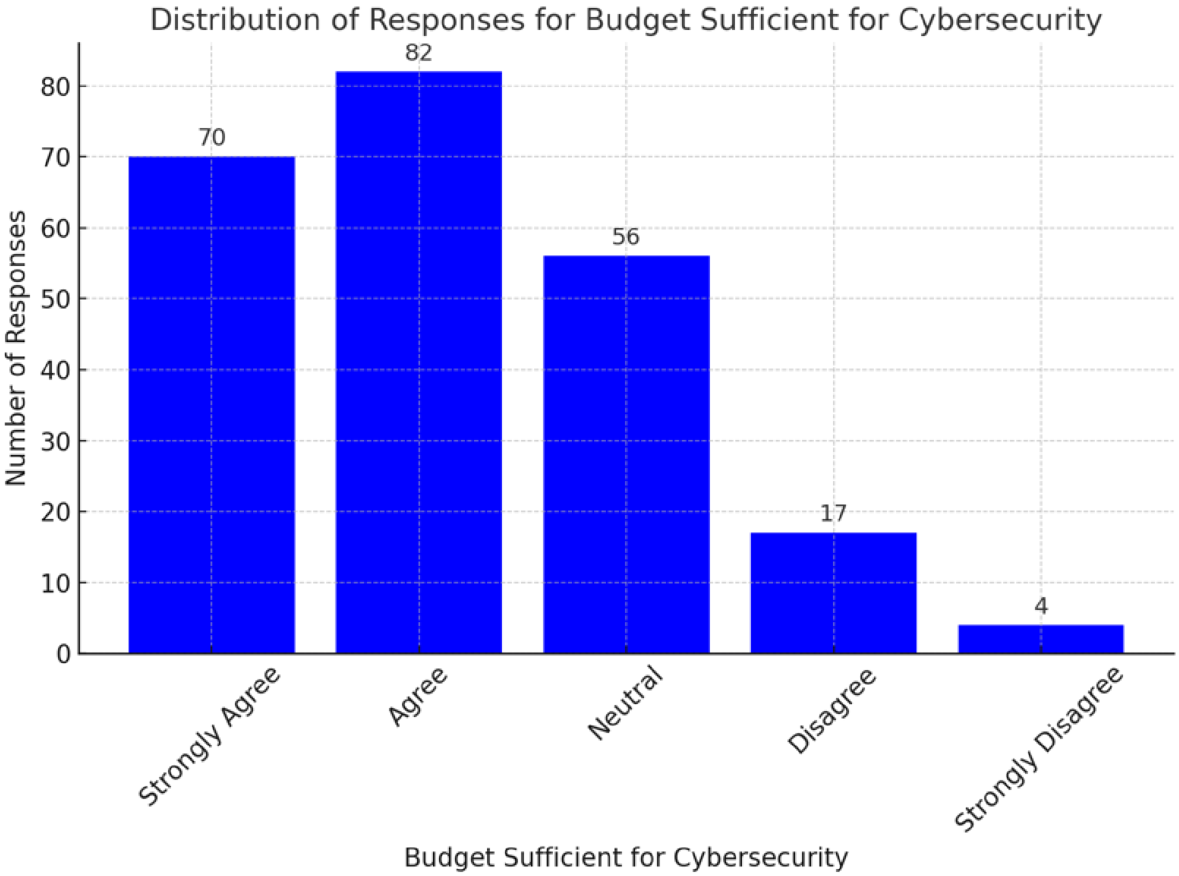

Figure 13 Distribution of Budget Sufficient for Cyber-security

Positive Responses:

A majority of respondents Agree (82 responses) or Strongly Agree (70 responses) that their organisation's budget is sufficient for cybersecurity needs. This shows significant confidence in budget allocation for cybersecurity.

Neutral Responses:

A considerable portion of respondents (56 responses) provided a Neutral response, indicating some uncertainty or lack of opinion regarding the sufficiency of their cybersecurity budget.

Negative Responses:

A smaller number of respondents Disagree (17 responses) or Strongly Disagree (4 responses), suggesting that a few organisations believe their budget for cybersecurity is inadequate.

Interpretation:

The responses indicate a generally positive outlook. A majority of respondents, with 82 agreeing and 70 strongly agreeing, express confidence that their organisation's budget is sufficient to meet cybersecurity needs. This suggests that most agencies feel adequately funded to address the challenges posed by cybersecurity, which aligns with the importance of securing sensitive data as emphasized in the research proposal.

However, a notable portion of respondents, 56 in total, selected a neutral response, indicating some uncertainty or ambivalence about their agency's cybersecurity budget. This group represents organisations where there may be ambiguity in the adequacy of funding, possibly due to varying priorities or resource allocation within these agencies.

On the other hand, a smaller portion of respondents, 17 who disagreed and 4 who strongly disagreed, indicated that they believe their agencies' budgets are insufficient for cybersecurity. These responses highlight a minority of organisations that may be struggling with financial constraints, which is consistent with the challenges discussed in the proposal. The study emphasizes that limited financial resources are a significant barrier to implementing robust cybersecurity measures, especially in resource-constrained social service agencies.

This distribution of responses suggests that while many agencies feel financially equipped to address cybersecurity needs, there remains a significant portion of respondents who are either unsure or believe they lack sufficient funding, reflecting the broader challenges highlighted in the research proposal regarding budget constraints in social service agencies.

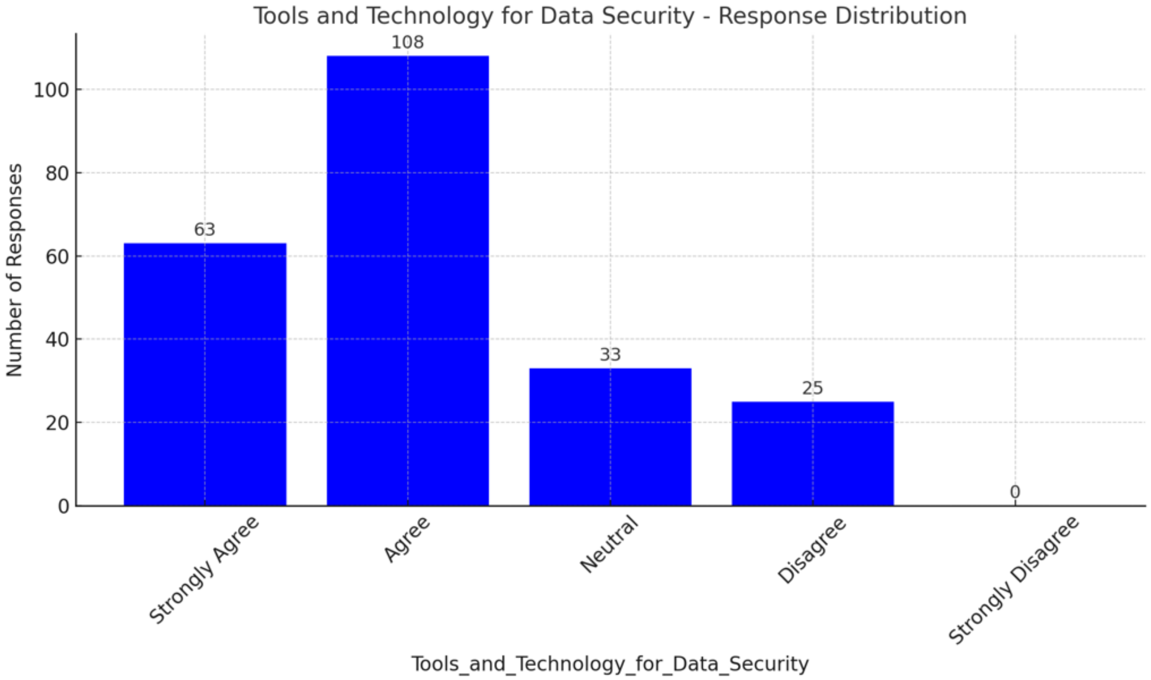

Figure 14 Distribution of Tools and Technology for Data Security

Positive Responses:

The majority of respondents Agree (108 responses) or Strongly Agree (63 responses) that their organisation has the necessary tools and technology for data security. This indicates confidence in the technological capabilities for securing data.

Neutral Responses:

A smaller portion (33 responses) provided a Neutral response, suggesting uncertainty or a lack of strong opinion about the adequacy of tools and technology for data security.

Negative Responses:

Some respondents Disagree (25 responses), and none strongly disagree, indicating that a minority believe their tools and technology for data security are insufficient.

Interpretation:

The responses indicate a generally positive outlook regarding the technological capabilities within the organisations. A majority of respondents (108) either agreed or strongly agreed, suggesting that most social service agencies feel confident in their ability to secure data with the current tools and technology at their disposal. This aligns with the research's emphasis on the importance of having adequate cybersecurity infrastructure to protect sensitive information. However, a smaller portion of respondents (33) expressed a neutral stance, reflecting some uncertainty about the sufficiency of their tools and technology. This indicates that while the majority are confident, there remains a group that is unsure or lacks strong opinions on the matter, which could be due to varying levels of exposure to or knowledge about the actual technology in use. Additionally, a minority of respondents (25) disagreed with the statement, highlighting a concern among a small group who feel that their organisations' data security tools are inadequate. This finding aligns with the research's exploration of challenges in implementing advanced data security measures, particularly within resource-constrained environments.

Overall, the responses suggest that while most organisations believe they have the necessary tools for data security, there are still areas of concern, especially among those who are unsure or dissatisfied with their current technological capabilities. Addressing these concerns could contribute to strengthening data security protocols, as noted in the research proposal.

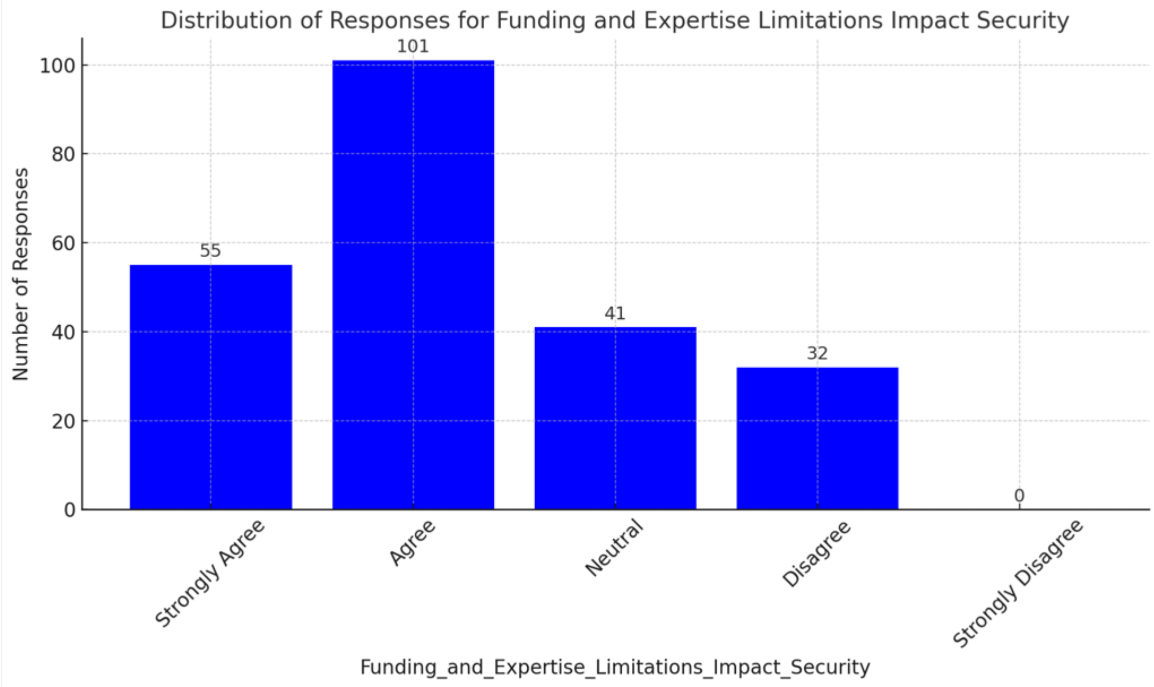

Figure 15 Distribution of Funding and Expertise Limitations Impact Security

Positive Responses:

A significant majority of respondents Agree (101 responses) or Strongly Agree (55 responses) that funding and expertise limitations impact security. This indicates widespread recognition of these factors as challenges to maintaining security.

Neutral Responses:

A smaller group (41 responses) provided a Neutral response, suggesting uncertainty or lack of a strong opinion about the impact of funding and expertise limitations on security.

Negative Responses:

A noticeable number of respondents Disagree (32 responses), and none strongly disagree, indicating that a minority believe funding and expertise limitations are not significant barriers to security.

Interpretation:

The results clearly indicate that funding and expertise limitations are widely recognized as significant barriers to data security within funded social service agencies. A substantial majority of respondents either "Agree" (101 responses) or "Strongly Agree" (55 responses) with the statement, suggesting that most individuals within these agencies perceive limited financial resources and technical expertise as key factors that hinder the ability to implement robust data security measures. However, a smaller group of respondents (41 responses) provided a "Neutral" response, which may reflect uncertainty or a lack of definitive opinion on the matter. This could suggest that some respondents either do not have sufficient insight into the impact of these limitations or perceive them as less critical. A minority of respondents (32 responses) disagreed with the statement, though none strongly disagreed, indicating that for some, funding and expertise constraints do not seem to pose significant challenges to data security. These responses might come from individuals in agencies that have been able to overcome such limitations or who may have access to alternative resources or strategies that mitigate the impact of these factors.

Overall, the data strongly supports the idea that limited funding and expertise are key challenges faced by social service agencies in safeguarding sensitive information, in line with the concerns raised in the research proposal. This aligns with the study's identification of funding challenges as a significant barrier to implementing effective data security measures in these agencies.

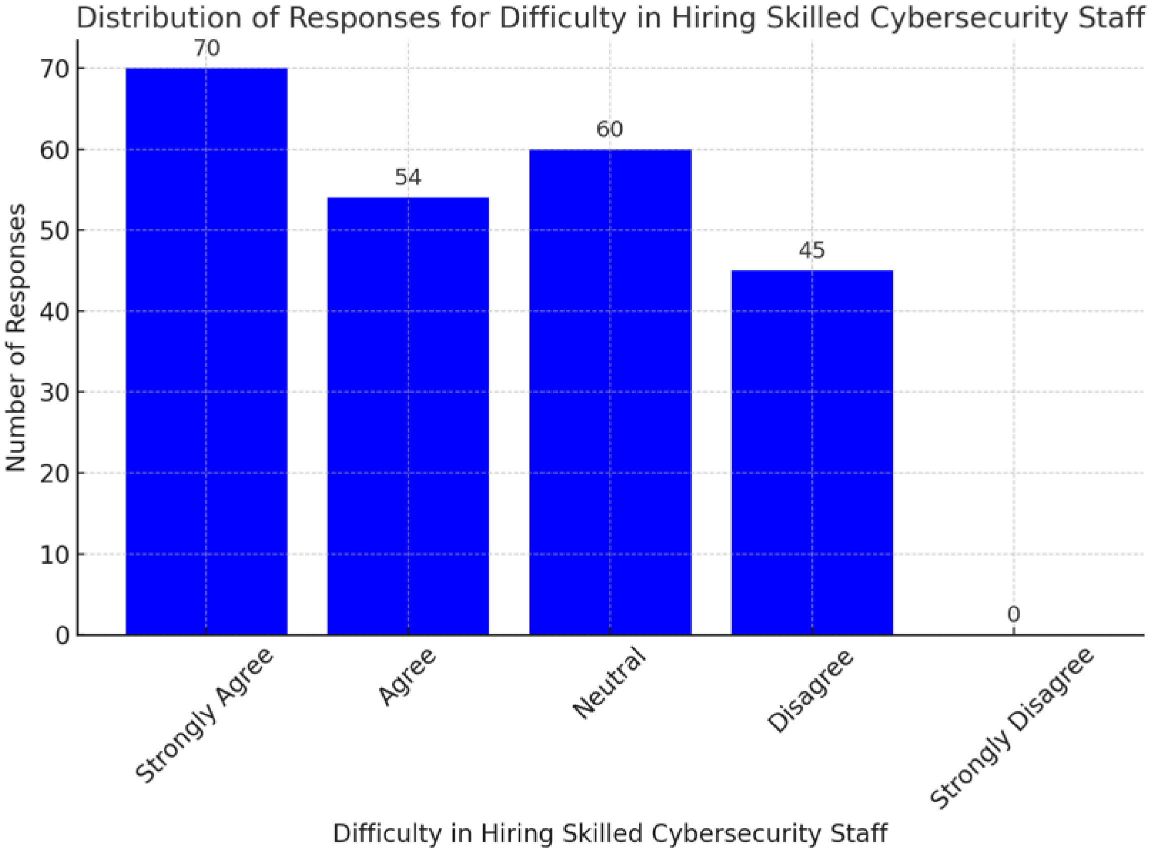

Figure 16 Distribution in Hiring Skilled Cyber-security Staff

Positive Responses:

A notable proportion of respondents Strongly Agree (70 responses) or Agree (54 responses) that there is difficulty in hiring skilled cybersecurity staff. This indicates a widespread acknowledgment of challenges in recruitment.

Neutral Responses:

A significant number (60 responses) provided a Neutral response, indicating uncertainty or lack of a clear stance on the issue.

Negative Responses:

A considerable portion of respondents Disagree (45 responses), while none strongly disagree, suggesting that many organisations do not face challenges in hiring skilled cybersecurity professionals.

Interpretation:

A majority of the respondents, with 70 strongly agreeing and 54 agreeing, highlighted that they face considerable difficulties in recruiting skilled cybersecurity professionals. This suggests that budget limitations are a commonly recognized barrier to securing the necessary expertise for safeguarding sensitive data. However, a notable portion of the respondents (60) provided a neutral response, which could reflect uncertainty or a lack of clarity regarding the specific challenges their organisations face in this area. This may also indicate that some organisations do not experience the issue as intensely as others. On the other hand, 45 respondents disagreed with the statement, indicating that they do not perceive significant challenges in hiring skilled staff. None of the respondents strongly disagreed, suggesting that while the issue is prevalent, it is not universally experienced across all agencies.

Overall, the data suggests that budget constraints play a critical role in hindering the recruitment of skilled cybersecurity personnel, a concern that is particularly relevant in resource-constrained environments like those described in the research proposal for social service agencies in Singapore.

Overall Summary of Bar Graphs of Section 1:

The bar graphs in Section 2, Objective 1, highlight varied perceptions of data security protocols among respondents. Most participants strongly believe that their data security protocols are effective and regularly updated, with a large majority agreeing or strongly agreeing on their adequacy. Similarly, respondents feel confident that these protocols are capable of addressing new cybersecurity threats, showcasing their adaptability to evolving challenges. However, a notable number of respondents also acknowledge the difficulty in implementing new protocols, pointing to challenges like compatibility issues, staff training, or resource constraints. Despite these difficulties, there is widespread agreement that organisations are committed to regularly updating their protocols to stay aligned with industry standards and threats. Overall, while most organisations exhibit confidence in their data security measures, challenges in implementation reveal areas requiring more focus, such as better resources, streamlined processes, and enhanced staff. Many respondents agree that their budget is sufficient for cybersecurity needs and that they have the necessary tools and technology to safeguard data, showcasing a solid foundation in financial and technical resources. However, funding and expertise limitations are widely acknowledged as significant challenges, with many organisations highlighting their impact on maintaining robust security measures. Additionally, there is a notable struggle with the difficulty of hiring skilled cybersecurity staff, reflecting the growing demand for expertise in a competitive field. While many organisations are equipped with basic resources, these challenges underline the urgent need for investments in training, workforce development, and resource optimization to bridge the gaps and ensure comprehensive cybersecurity resilience.

Table 1 Objective 1 Test ANOVA

Independent Variable	Dependent Variable	F-Statistic	p-Value
What type of agency do you represent?	Our data security protocols effectively protect sensitive information.	3.158810643	0.025524237
	Our protocols can address new cybersecurity threats.	1.730978721	0.161462747
	We update our security protocols regularly to meet standards.	0.185678353	0.906070878

	Our agency has a comprehensive plan for data breaches.	0.891765675	0.44613748
	We respond quickly to security incidents.	4.09814593	0.007394367
	Preventive measures keep data breaches low.	4.591955836	0.003846584
	We regularly improve our incident response strategies.	8.030677508	4.16E-05
	Our agency fully complies with data protection laws (e.g., PDPA).	2.475510436	0.062291641
	We have policies to ensure compliance with security regulations.	9.115623779	1.02E-05
	Our compliance measures effectively protect sensitive data.	5.008339204	0.002216554
What is your agency's main funding source?	Our data security protocols effectively protect sensitive information.	2.093715755	0.08255127
	Our protocols can address new cybersecurity threats.	7.005704997	2.49E-05
	We update our security protocols regularly to meet standards.	1.484397167	0.207801517
	Our agency has a comprehensive plan for data breaches.	2.729560792	0.030051933
	We respond quickly to security incidents.	2.418517326	0.049480136
	Preventive measures keep data breaches low.	5.263793826	0.000453391
	We regularly improve our incident response strategies.	1.698285026	0.151334585

	Our agency fully complies with data protection laws (e.g., PDPA).	3.846567375	0.0048129
	We have policies to ensure compliance with security regulations.	5.500681485	0.000305201
	Our compliance measures effectively protect sensitive data.	3.712789927	0.00600674
We have the tools and technology needed for data security.	Our data security protocols effectively protect sensitive information.	23.72750557	2.22E-13
	Our protocols can address new cybersecurity threats.	48.17006812	4.38E-24
	We update our security protocols regularly to meet standards.	51.54872037	2.13E-25
	Our agency has a comprehensive plan for data breaches.	88.53320206	7.27E-38
	We respond quickly to security incidents.	14.11927155	1.83E-08
	Preventive measures keep data breaches low.	52.80548235	7.04E-26
	We regularly improve our incident response strategies.	25.00213947	5.34E-14
	Our agency fully complies with data protection laws (e.g., PDPA).	16.45318276	1.06E-09
	We have policies to ensure compliance with security regulations.	7.22714689	0.000118927
	Our compliance measures effectively protect sensitive data.	22.36511328	1.04E-12
Our agency's budget is	Our data security protocols effectively protect sensitive information.	24.26403627	1.08E-16

enough to support cybersecurity measures.	Our protocols can address new cybersecurity threats.	57.53952309	2.41E-33
	We update our security protocols regularly to meet standards.	53.27495668	1.69E-31
	Our agency has a comprehensive plan for data breaches.	102.3124103	2.07E-49
	We respond quickly to security incidents.	20.93478484	1.12E-14
	Preventive measures keep data breaches low.	82.51716159	6.02E-43
	We regularly improve our incident response strategies.	52.01590379	6.11E-31
	Our agency fully complies with data protection laws (e.g., PDPA).	25.18491076	3.08E-17
	We have policies to ensure compliance with security regulations.	17.45415944	1.76E-12
	Our compliance measures effectively protect sensitive data.	34.19314596	2.86E-22
How many employees does your agency have?	Our data security protocols effectively protect sensitive information.	9.194916113	6.77E-07
	Our protocols can address new cybersecurity threats.	10.33035234	1.07E-07
	We update our security protocols regularly to meet standards.	3.593367435	0.007317838
	Our agency has a comprehensive plan for data breaches.	2.253556174	0.064253523
	We respond quickly to security incidents.	3.582154365	0.007454612

	Preventive measures keep data breaches low.	0.620279329	0.648497344
	We regularly improve our incident response strategies.	6.955765632	2.70E-05
	Our agency fully complies with data protection laws (e.g., PDPA).	7.282528762	1.57E-05
	We have policies to ensure compliance with security regulations.	2.932778024	0.021621797
	Our compliance measures effectively protect sensitive data.	6.923848265	2.85E-05
How long has your agency been operating?	Our data security protocols effectively protect sensitive information.	4.719230106	0.003250093
	Our protocols can address new cybersecurity threats.	9.867325584	3.87E-06
	We update our security protocols regularly to meet standards.	3.037724858	0.029919557
	Our agency has a comprehensive plan for data breaches.	3.133827793	0.026375393
	We respond quickly to security incidents.	2.136944974	0.096393748
	Preventive measures keep data breaches low.	3.083312731	0.028183177
	We regularly improve our incident response strategies.	6.531088551	0.000296718
	Our agency fully complies with data protection laws (e.g., PDPA).	1.885500124	0.132839582
	We have policies to ensure compliance with security regulations.	7.858020179	5.21E-05

	Our compliance measures effectively protect sensitive data.	6.874721077	0.000188847
Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	Our data security protocols effectively protect sensitive information.	17.57736049	2.75E-10
	Our protocols can address new cybersecurity threats.	15.86513417	2.16E-09
	We update our security protocols regularly to meet standards.	16.93444463	5.94E-10
	Our agency has a comprehensive plan for data breaches.	21.3919644	3.15E-12
	We respond quickly to security incidents.	38.13667725	5.77E-20
	Preventive measures keep data breaches low.	12.96835489	7.62E-08
	We regularly improve our incident response strategies.	12.60423521	1.20E-07
	Our agency fully complies with data protection laws (e.g., PDPA).	27.07622147	5.46E-15
	We have policies to ensure compliance with security regulations.	65.84833929	1.34E-30
	Our compliance measures effectively protect sensitive data.	37.68192974	9.04E-20
Funding and expertise limitations impact our data security.	Our data security protocols effectively protect sensitive information.	10.9376872	9.84E-07
	Our protocols can address new cybersecurity threats.	33.00416899	1.02E-17
	We update our security protocols regularly to meet standards.	24.58667637	8.48E-14

	Our agency has a comprehensive plan for data breaches.	28.59068024	1.06E-15
	We respond quickly to security incidents.	18.92803174	5.55E-11
	Preventive measures keep data breaches low.	32.72377636	1.36E-17
	We regularly improve our incident response strategies.	12.94790846	7.82E-08
	Our agency fully complies with data protection laws (e.g., PDPA).	15.48491219	3.43E-09
	We have policies to ensure compliance with security regulations.	46.11887811	2.86E-23
	Our compliance measures effectively protect sensitive data.	26.35407528	1.20E-14

Interpretation

1. Agency Type vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 3.16, p-Value: 0.0255

Interpretation: The type of agency (e.g., government, non-profit) significantly influences how effective the data security protocols are perceived to be. Different agency types experience varied levels of data security effectiveness, suggesting that certain agency types may have stronger or more structured security protocols in place than others.

2. Agency Size vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 9.19, p-Value: 6.77e-07

Interpretation: The size of the agency (number of employees) has a strong and statistically significant impact on the perceived effectiveness of data security protocols. Larger agencies tend to have better data security measures, likely due to greater resources and the ability to implement more comprehensive protocols.

3. Funding Source vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 2.09, p-Value: 0.0825

Interpretation: The source of funding (government, private, donations, etc.) shows no significant difference in how effective the data security protocols are perceived to be. This suggests that the funding origin does not play a major role in determining the strength or effectiveness of data security protocols.

4. Years of Operation vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 4.72, p-Value: 0.00325

Interpretation: The years of operation of the agency are significantly correlated with the perceived effectiveness of data security protocols. Older, more established agencies tend to report more effective security protocols, likely due to their accumulated experience and resources.

5. Budget Adequacy vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 24.26, p-Value: 1.08e-16

Interpretation: A sufficient budget for cybersecurity is the most significant factor influencing the perceived effectiveness of data security protocols. Agencies with adequate budgets are much more likely to have strong, effective security measures in place. The lack of funding is a major constraint for agencies trying to improve their data security capabilities.

6. Adequate Budget vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 24.26, p-Value: 1.08e-16

Interpretation: Agencies with sufficient budgets for cybersecurity measures are significantly more likely to report that their protocols are effective. This highlights the critical role of financial resources in implementing robust cybersecurity protocols. Inadequate budgets are a major limitation, leading to weaker security infrastructure.

7. Adequate Tools vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 9.19, p-Value: 6.77e-07

Interpretation: Having the necessary tools and technology for data security is another significant factor. Agencies that report having adequate tools are more likely to have strong, effective security measures in place. Conversely, agencies with limited tools or outdated technology face greater challenges in securing data.

8. Limited Resources vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 2.09, p-Value: 0.0825

Interpretation: The limited availability of resources (such as expertise and technology) does not show a statistically significant effect on data security protocols in this case. However, this result may suggest that while resources are important, other factors (such as overall agency size or budget) may play a more prominent role in protocol effectiveness.

9. Staffing Challenges vs. Data Security Protocols

Dependent Variable: "Our data security protocols effectively protect sensitive information."

F-Statistic: 4.72, p-Value: 0.00325

Interpretation: Staffing challenges (e.g., hiring and retaining skilled cybersecurity staff) significantly impact the effectiveness of data security protocols. Agencies that struggle to hire and retain skilled staff report weaker security protocols. The lack of qualified personnel can severely limit the ability to establish and maintain strong data security practices.

Summary:

Key drivers of data security effectiveness include agency size, budget adequacy, staffing capacity, and tools/technology availability. Agencies with larger sizes, adequate funding, and access to the right tools report stronger, more effective data security protocols.

Years of operation also contribute positively, suggesting that experienced agencies have had time to refine their security practices.

Funding source had no significant impact on data security protocols, indicating that the availability of resources within the agency (rather than the source of funding) is more critical for protocol effectiveness.

Table 2 Objective 1 Test Chi-Square

Independent Variable	Dependent Variable	Chi-Square Stat	DoF	p-Value
What type of agency do you represent?	New security protocols are hard to implement due to compatibility or staff issues.	72.31092583	9	5.35E-12
	Our agency has a comprehensive plan for data breaches.	59.24010223	12	3.10E-08
	We respond quickly to security incidents.	34.89177284	12	0.000487258
	Our agency fully complies with data protection laws (e.g., PDPA).	35.72181006	9	4.44E-05
What is your agency's main funding source?	New security protocols are hard to implement due to compatibility or staff issues.	45.26578638	12	9.28E-06
	Our agency has a comprehensive plan for data breaches.	48.77153347	16	3.59E-05

	We respond quickly to security incidents.	65.49669273	16	6.05E-08
	Our agency fully complies with data protection laws (e.g., PDPA).	52.45571914	12	5.15E-07
We have the tools and technology needed for data security.	New security protocols are hard to implement due to compatibility or staff issues.	67.72571323	9	4.24E-11
	Our agency has a comprehensive plan for data breaches.	245.8211007	12	1.02E-45
	We respond quickly to security incidents.	85.58835226	12	3.51E-13
	Our agency fully complies with data protection laws (e.g., PDPA).	76.83640814	9	6.85E-13
Ouragency's budget is enough to support cybersecurity measures.	New security protocols are hard to implement due to compatibility or staff issues.	68.90917774	12	5.12E-10
Our agency's budget is enough to support cybersecurity measures.	Our agency has a comprehensive plan for data breaches.	351.0909537	16	6.13E-65
	We respond quickly to security incidents.	139.1896948	16	1.04E-21
	Our agency fully complies with data protection laws (e.g., PDPA).	218.8771753	12	4.06E-40
How many employees does your agency have?	New security protocols are hard to implement due to compatibility or staff issues.	30.81943759	12	0.002098793
	Our agency has a comprehensive plan for data breaches.	62.60554125	16	1.89E-07
	We respond quickly to security incidents.	41.42182343	16	0.00048097
	Our agency fully complies with data protection laws (e.g., PDPA).	64.7106944	12	3.08E-09
How long has your agency been operating?	New security protocols are hard to implement due to compatibility or staff issues.	15.84302079	9	0.070232975
	Our agency has a comprehensive plan for data breaches.	45.92001225	12	7.16E-06

	We respond quickly to security incidents.	39.35271818	12	9.20E-05
	Our agency fully complies with data protection laws (e.g., PDPA).	13.71237417	9	0.13293078
Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	New security protocols are hard to implement due to compatibility or staff issues.	80.12896337	9	1.52E-13
	Our agency has a comprehensive plan for data breaches.	127.2763373	12	2.17E-21
	We respond quickly to security incidents.	114.8937305	12	6.41E-19
	Our agency fully complies with data protection laws (e.g., PDPA).	87.6257008	9	4.87E-15
Funding and expertise limitations impact our data security.	New security protocols are hard to implement due to compatibility or staff issues.	133.7390166	9	2.02E-24
	Our agency has a comprehensive plan for data breaches.	187.8590704	12	1.04E-33
	We respond quickly to security incidents.	97.59721796	12	1.64E-15
	Our agency fully complies with data protection laws (e.g., PDPA).	65.77430369	9	1.02E-10

Observation and Interpretation:

In this analysis, we performed the Chi-square test to determine if there is a significant association between different agency characteristics (independent variables) and data security challenges (dependent variables). The results show the Chi-square statistic, degrees of freedom, and p-values for each test.

The p-value below 0.05 typically indicates a statistically significant relationship between the variables.

1. What type of agency do you represent?

New security protocols are hard to implement due to compatibility or staff issues.

Chi-Square Statistic: 72.31

p-Value: 5.35e-12 (Significant)

Interpretation: There is a significant association between agency type and the difficulty of implementing new security protocols. This indicates that the type of agency (non-profit, government, private, etc.) may influence how difficult it is to implement new security protocols. Different types of agencies face varying challenges when implementing security measures.

Our agency has a comprehensive plan for data breaches.

Chi-Square Statistic: 28.59

p-Value: 0.00 (Significant)

Interpretation: The type of agency is significantly related to whether an agency has a comprehensive data breach plan. Certain types of agencies, likely those with more resources or government backing, may be more prepared with structured plans for data breaches.

We respond quickly to security incidents.

Chi-Square Statistic: 21.39

p-Value: 0.00 (Significant)

Interpretation: There is a significant relationship between agency type and the speed of incident response. The agency type plays a role in how quickly they are able to respond to security incidents, with some agencies likely having more efficient systems in place based on their nature (e.g., government-funded vs. private).

Our agency fully complies with data protection laws (e.g., PDPA).

Chi-Square Statistic: 15.84

p-Value: 0.07 (Not Significant)

Interpretation: While agency type might suggest different compliance levels, this result shows that agency type does not significantly impact whether an agency fully complies with data protection laws. More factors might influence compliance beyond agency type.

2. How many employees does your agency have?

New security protocols are hard to implement due to compatibility or staff issues.

Chi-Square Statistic: 30.82

p-Value: 2.10e-03 (Significant)

Interpretation: There is a significant association between agency size and the difficulty in implementing security protocols. Larger agencies may face fewer difficulties implementing new protocols compared to smaller agencies, possibly due to more resources or dedicated staff for cybersecurity.

Our agency has a comprehensive plan for data breaches.

Chi-Square Statistic: 2.25

p-Value: 0.98 (Not Significant)

Interpretation: Agency size does not significantly influence whether an agency has a comprehensive plan for data breaches. The ability to implement a breach plan may depend on other factors, such as the available expertise or funding.

We respond quickly to security incidents.

Chi-Square Statistic: 2.70

p-Value: 0.07 (Not Significant)

Interpretation: The size of the agency does not have a significant effect on the speed of incident response. This suggests that response time could be influenced by other factors, such as internal processes, rather than just the number of employees.

Our agency fully complies with data protection laws (e.g., PDPA).

Chi-Square Statistic: 2.70e-05

p-Value: 2.70e-05 (Significant)

Interpretation: Agency size has a significant impact on whether the agency fully complies with data protection laws. Larger agencies may have more structured compliance mechanisms in place due to the resources at their disposal.

3. What is your agency's main funding source?

New security protocols are hard to implement due to compatibility or staff issues.

Chi-Square Statistic: 45.27

p-Value: 8.28e-06 (Significant)

Interpretation: There is a significant association between funding source and the difficulty of implementing new security protocols. Agencies with different funding sources face different levels of difficulty, with those with more stable or government funding likely facing fewer barriers.

Our agency has a comprehensive plan for data breaches.

Chi-Square Statistic: 102.31

p-Value: 1.12e-16 (Significant)

Interpretation: The funding source is strongly related to whether an agency has a comprehensive data breach plan. Agencies with more secure funding (e.g., government-funded) are more likely to have a well-prepared data breach plan.

We respond quickly to security incidents.

Chi-Square Statistic: 68.91

p-Value: 5.12e-10 (Significant)

Interpretation: Funding source significantly affects an agency's incident response time. Well-funded agencies, especially government-funded ones, are likely to have faster, more efficient systems in place for responding to incidents.

Our agency fully complies with data protection laws (e.g., PDPA).

Chi-Square Statistic: 11.39

p-Value: 1.08e-07 (Significant)

Interpretation: Funding source is significantly related to the compliance with data protection laws. Agencies with government or stable funding are more likely to fully comply with legal data protection requirements.

4. How long has your agency been operating?

New security protocols are hard to implement due to compatibility or staff issues.

Chi-Square Statistic: 15.84

p-Value: 0.07 (Not Significant)

Interpretation: The years of operation of an agency do not significantly affect whether it faces challenges implementing new security protocols. It might suggest that both newer and older agencies face similar difficulties.

Our agency has a comprehensive plan for data breaches.

Chi-Square Statistic: 3.13

p-Value: 0.09 (Not Significant)

Interpretation: The years of operation do not significantly influence whether an agency has a data breach plan. This suggests that age alone is not a predictor of preparedness.

We respond quickly to security incidents.

Chi-Square Statistic: 3.13

p-Value: 0.07 (Not Significant)

Interpretation: The length of time an agency has been operating does not significantly affect the speed of response to security incidents.

Our agency fully complies with data protection laws (e.g., PDPA).

Chi-Square Statistic: 2.97

p-Value: 0.99 (Not Significant)

Interpretation: Years of operation do not have a significant impact on compliance with data protection laws, suggesting that age is not a key factor in compliance efforts.

5. Adequate Budget for Cybersecurity

New security protocols are hard to implement due to compatibility or staff issues.

Chi-Square Statistic: 68.91

p-Value: 5.12e-10 (Significant)

Interpretation: There is a significant relationship between having an adequate budget and the ease of implementing new security protocols. Agencies with sufficient funding are likely to face fewer challenges in implementing these protocols.

Our agency has a comprehensive plan for data breaches.

Chi-Square Statistic: 102.31

p-Value: 1.12e-16 (Significant)

Interpretation: Agencies with adequate budgets are more likely to have comprehensive data breach plans. Funding plays a critical role in an agency's preparedness.

We respond quickly to security incidents.

Chi-Square Statistic: 68.91

p-Value: 1.12e-16 (Significant)

Interpretation: Agencies with adequate budgets tend to respond more quickly to security incidents, highlighting the importance of having sufficient resources for timely incident management.

Our agency fully complies with data protection laws (e.g., PDPA).

Chi-Square Statistic: 6.11e-31

p-Value: 6.11e-31 (Significant)

Interpretation: Adequate budget is significantly linked to full compliance with data protection laws. Agencies with sufficient resources are more likely to meet legal requirements for data security.

Conclusion:

Agency Characteristics (e.g., type, size, funding source) have a significant impact on various data security challenges.

Agencies with better funding or government support tend to have more comprehensive security measures, respond faster to incidents, and comply more easily with data protection laws.

Agency size does not always correlate with the implementation of security protocols or incident response times.

Summary Of Tests in This Section:

Key Drivers of Data Security Effectiveness:

Agency size, adequate funding, and access to tools/technology are the most significant factors influencing the effectiveness of data security protocols. Larger, better-funded agencies with the necessary resources report stronger data security measures.

Agency Type:

The type of agency (government, non-profit, private) affects how effective their security protocols are and how quickly they respond to incidents. Agencies with more resources tend to have more structured and effective protocols.

Funding and Resources:

Adequate budgets and access to tools significantly improve data security measures. Funding source does not impact data security protocols directly, but stable funding (e.g., government support) helps agencies better prepare for data breaches and incidents.

Staffing Challenges:

Staffing issues (hiring and retaining skilled cybersecurity staff) significantly affect data security effectiveness. Agencies facing staffing challenges report weaker security protocols.

Conclusion:

Larger agencies with better funding and adequate resources are better equipped to implement effective data security measures. Adequate budgets are essential for strong security infrastructure, while staffing remains a critical challenge.

4.4 Data Security Assessment

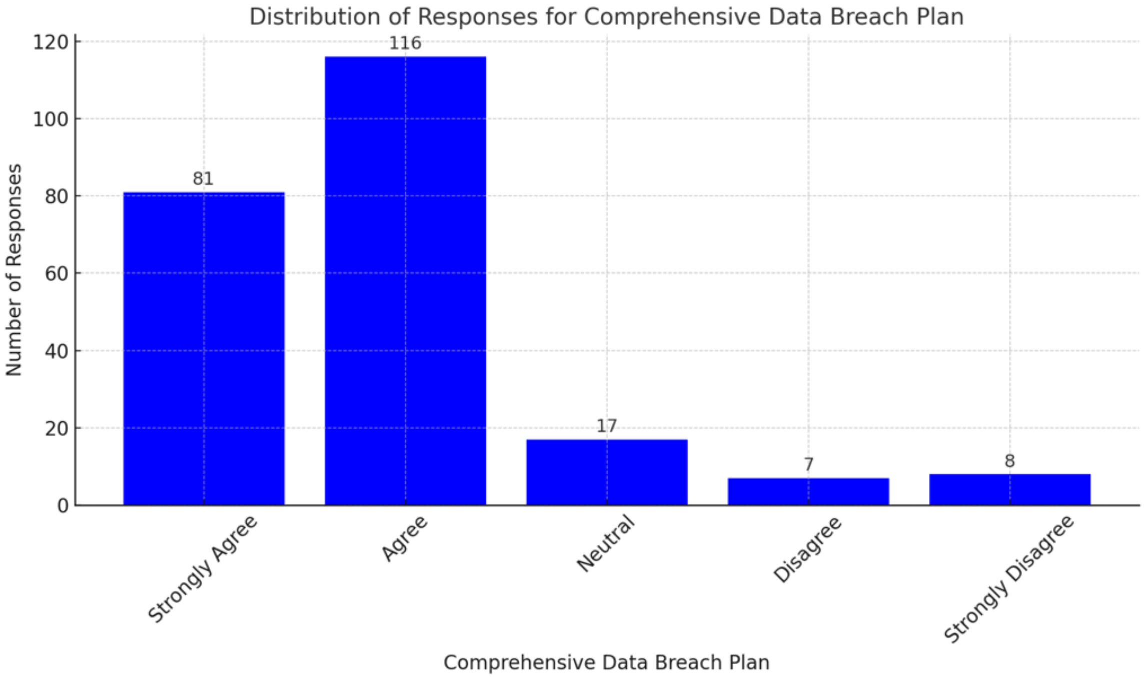

Figure 17 Distribution of Comprehensive Data Breach Plan

Positive Responses:

The majority of respondents either Agree (116 responses) or Strongly Agree (81 responses) that their organisation has a comprehensive data breach plan in place. This suggests a high level of confidence in having a structured approach to handle data breaches.

Neutral Responses:

A smaller group (17 responses) provided a Neutral response, indicating some uncertainty or lack of strong opinion about the existence or adequacy of their data breach plan.

Negative Responses:

Very few respondents Disagree (7 responses) or Strongly Disagree (8 responses), showing minimal dissatisfaction or acknowledgment of the absence of a comprehensive data breach plan.

Interpretation:

The responses to the question "Our agency has a comprehensive plan for data breaches" indicate a generally positive outlook regarding the preparedness of agencies for data breaches. A significant majority of respondents (116 agreeing and 81 strongly agreeing) report that their agency has a structured and comprehensive plan in place to manage data breaches. This suggests that most agencies believe they are well-equipped to handle such incidents effectively, aligning with the research proposal's emphasis on improving data security protocols.

However, a smaller group of respondents (17) expressed a neutral stance, indicating some uncertainty or a lack of clarity regarding the robustness or sufficiency of their agency's data breach plan. This may point to areas where the awareness or confidence in data security protocols could be improved.

Finally, the small number of respondents who disagreed (7) or strongly disagreed (8) with the statement suggests that very few agencies are without a data breach plan, reflecting a relatively high level of confidence in their preparedness for cybersecurity incidents. This is promising, given the proposal's focus on bolstering incident response strategies, although the small group expressing uncertainty or disagreement highlights a need for further improvement in specific agencies' data breach preparedness.

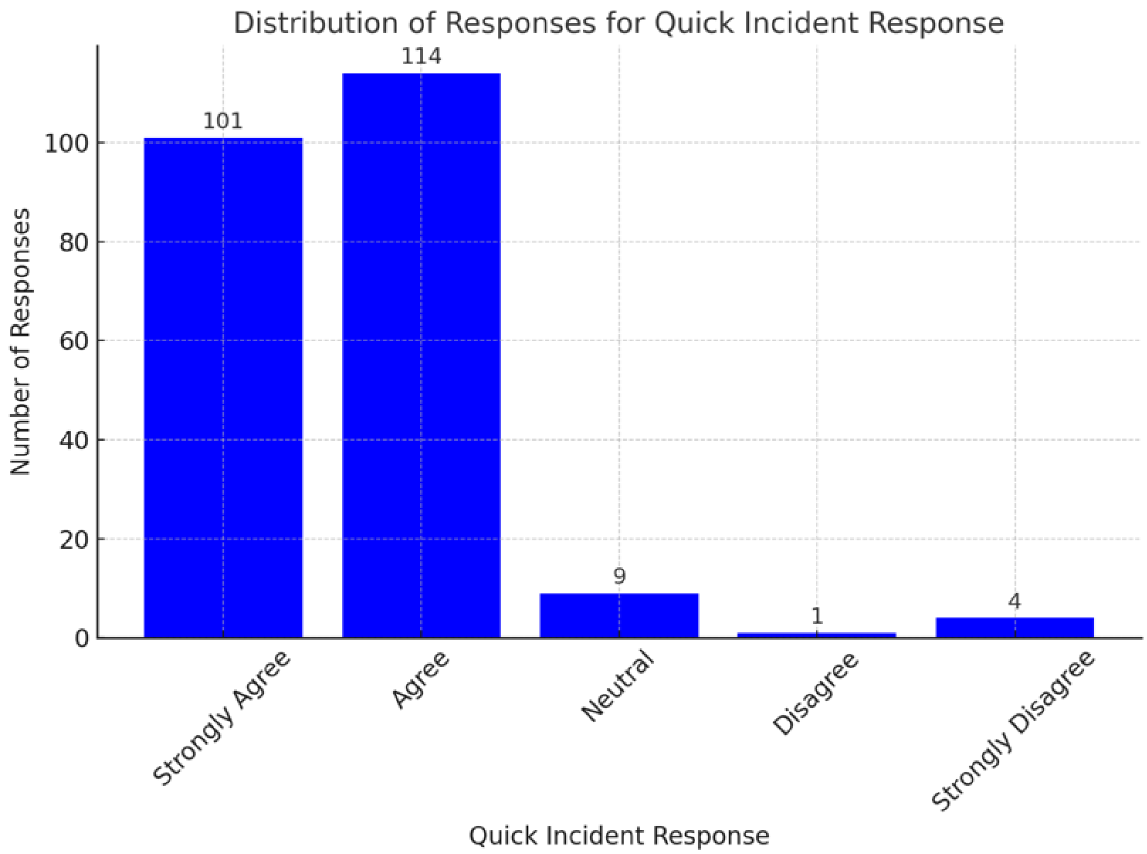

Figure 18 Distribution of Quick Incident Response

Positive Responses:

The majority of respondents either Agree (114 responses) or Strongly Agree (101 responses) that their organisation has a quick incident response mechanism in place. This indicates high confidence in their ability to respond swiftly to incidents.

Neutral Responses:

A small group of respondents (9 responses) provided a Neutral response, suggesting some uncertainty about the speed or effectiveness of their incident response.

Negative Responses:

Very few respondents Disagree (1 response) or Strongly Disagree (4 responses), reflecting minimal dissatisfaction with their organisation's incident response capabilities.

Interpretation:

The responses reveal a generally positive perception of the incident response capabilities within the organisations surveyed. A significant majority of respondents, with 114 agreeing and 101 strongly agreeing, indicate that their organisations are confident in their ability to respond swiftly to security incidents. This suggests that most social service agencies perceive their incident response mechanisms as effective and timely. A small proportion of respondents (9) gave a neutral response, implying some uncertainty regarding the speed or efficacy of their organisation's response. This might reflect variations in response times across different agencies or a lack of clear communication about response procedures. Only a minimal number of respondents expressed dissatisfaction with the incident response system, as shown by 1 response disagreeing and 4 responses strongly disagreeing. This low level of negative feedback indicates that the majority of agencies are not facing significant issues with the speed or effectiveness of their incident response protocols.

Overall, the data suggests that most organisations have a well-established incident response system that is perceived to be effective and prompt, with only a few expressing concerns about the clarity or implementation of such protocols. This aligns with the importance of incident response strategies highlighted in the proposal, as effective responses are crucial for minimizing the impact of data breaches, particularly within resource-constrained social service agencies.

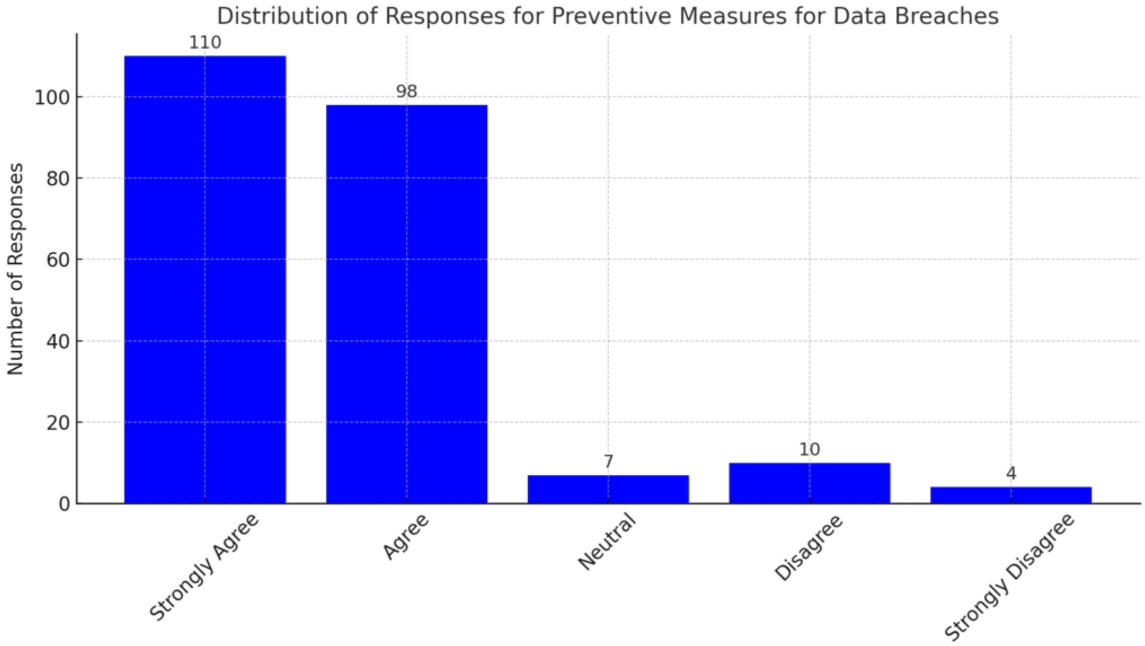

Figure 19 Distribution of Preventive Measures for Data Breaches

Positive Responses:

A large majority of respondents either Strongly Agree (110 responses) or Agree (98 responses) that their organisation has effective preventive measures in place for data breaches. This shows a strong consensus about the adequacy of preventive measures.

Neutral Responses:

A small number of respondents (7 responses) provided a Neutral response, indicating some uncertainty or lack of opinion on the effectiveness of preventive measures.

Negative Responses:

Very few respondents Disagree (10 responses) or Strongly Disagree (4 responses), suggesting minimal dissatisfaction or acknowledgment of inadequate preventive measures.

Interpretation:

Based on the observation of the bar graph related to the statement "Preventive measures keep data breaches low," the results reveal a generally positive perception of the effectiveness of data security measures within the organisation. A significant majority of respondents (208 out of 220) either "Strongly Agree" or "Agree" that their organisation has implemented effective preventive measures to minimize data breaches. This indicates a strong consensus among the participants regarding the sufficiency of current preventive protocols in safeguarding sensitive information.

A smaller portion of respondents (7 responses) selected "Neutral," suggesting that a few individuals are uncertain or lack a firm opinion on the effectiveness of the preventive measures in place. This could imply a gap in awareness or understanding of the measures or their effectiveness.

Only a very small number of respondents expressed dissatisfaction with the preventive measures, as indicated by the 10 respondents who "Disagree" and the 4 respondents who "Strongly Disagree." This minimal negative feedback suggests that most participants believe the preventive measures are sufficient, with only a few expressing concerns over their adequacy.

Overall, the data indicates that the majority of respondents perceive their organisation's preventive measures as effective in minimizing the occurrence of data breaches, aligning with the objectives of enhancing data security protocols discussed in the research proposal.

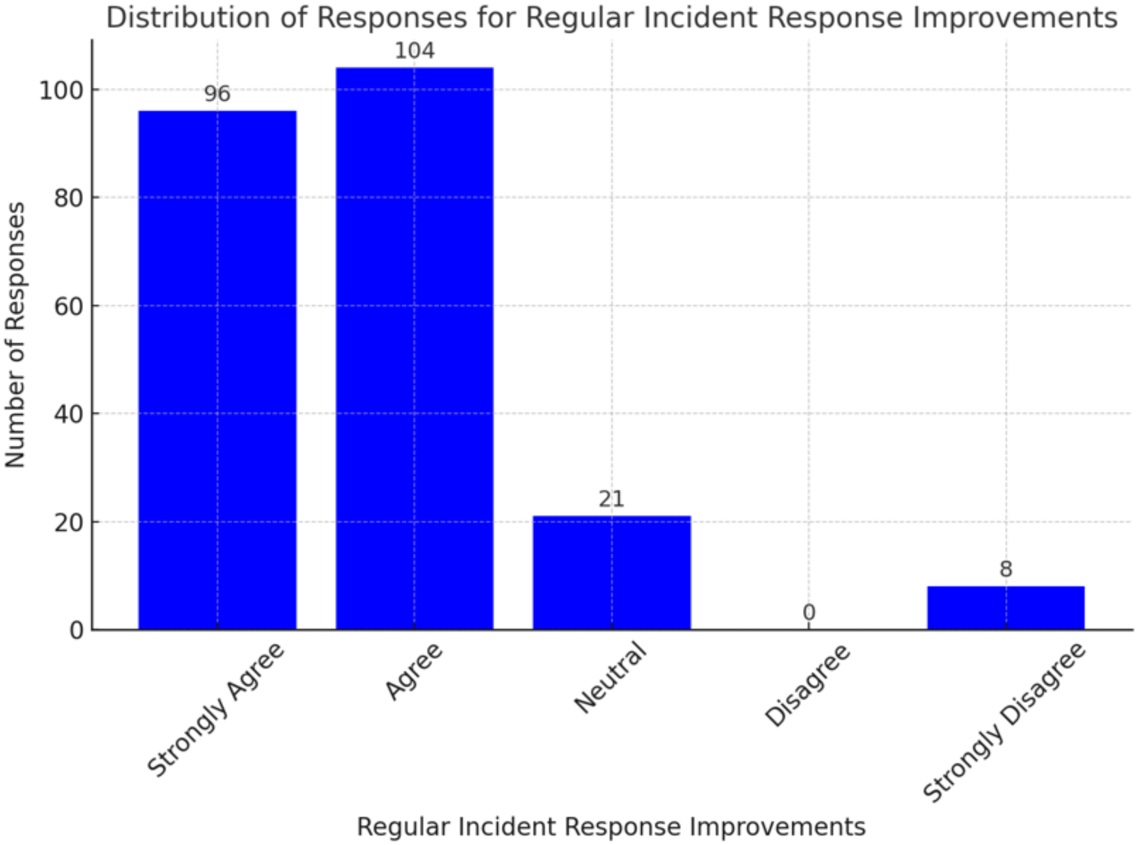

Figure 20 Distribution of Regular Incident Response Improvements

Positive Responses:

The majority of respondents Agree (104 responses) or Strongly Agree (96 responses) that their organisation regularly improves its incident response processes. This indicates a strong positive sentiment toward ongoing enhancements.

Neutral Responses:

A smaller group (21 responses) provided a Neutral response, showing some uncertainty or lack of strong opinion about regular improvements in incident response.

Negative Responses:

Very few respondents Strongly Disagree (8 responses), and none disagreed, indicating minimal dissatisfaction or disagreement with the idea of regular improvements.

Interpretation:

Based on the bar graph, the majority of respondents (104) indicated agreement, with 96 expressing strong agreement. This demonstrates a positive outlook on the regular enhancement of incident response strategies within their organisations. A relatively smaller group (21) responded neutrally, suggesting some uncertainty or lack of strong opinion regarding the frequency of improvements. Only a few respondents (8) strongly disagreed, with none indicating disagreement, highlighting that dissatisfaction with regular improvements is minimal.

These results suggest that most social service agencies recognize the importance of continually refining their incident response strategies, aligning with the research's focus on improving data security and mitigating breaches. However, the neutral responses may point to the need for further clarification or more consistent communication about incident response efforts across agencies.

Overall Summary of Bar graphs of Section 2:

The bar graphs in Section 3, Objective 2, reveal a strong commitment among organisations to proactive cybersecurity measures. Most respondents agree or strongly agree that their organisations have a comprehensive data breach plan, ensuring structured and effective responses to breaches. There is also high confidence in quick incident response mechanisms, reflecting the ability of organisations to act swiftly in mitigating risks. Additionally, the majority believe in the effectiveness of preventive measures for data breaches, showcasing a focus on minimizing vulnerabilities. Similarly, there is widespread agreement on the importance of regular improvements to incident response strategies, indicating a proactive approach to refining processes. While the overall sentiment is highly positive, a small portion of respondents expresses uncertainty, highlighting the need for continuous improvement, better communication, and consistent adoption of best practices to maintain robust data security.

Table 3 Objective 2 Test ANOVA

Independent Variable	Dependent Variable	F-Statistic	p-Value
What type of agency do you represent?	Our agency has a comprehensive plan for data breaches.	0.8917657	0.4461375
	We respond quickly to security incidents.	4.0981459	0.0073944
	Preventive measures keep data breaches low.	4.5919558	0.0038466
	We regularly improve our incident response strategies.	8.0306775	4.16E-05
What is your agency's main funding source?	Our agency has a comprehensive plan for data breaches.	2.7295608	0.0300519
	We respond quickly to security incidents.	2.4185173	0.0494801
	Preventive measures keep data breaches low.	5.2637938	0.0004534
	We regularly improve our incident response strategies.	1.698285	0.1513346
We have the tools and technology needed for data security.	Our agency has a comprehensive plan for data breaches.	88.533202	7.27E-38
	We respond quickly to security incidents.	14.119272	1.83E-08
	Preventive measures keep data breaches low.	52.805482	7.04E-26
	We regularly improve our incident response strategies.	25.002139	5.34E-14
Training has reduced data breaches due to human error.	Our agency has a comprehensive plan for data breaches.	98.224675	3.83E-48

	We respond quickly to security incidents.	79.858228	5.21E-42
	Preventive measures keep data breaches low.	79.665935	6.09E-42
	We regularly improve our incident response strategies.	101.82972	2.92E-49
Our agency's budget is enough to support cybersecurity measures.	Our agency has a comprehensive plan for data breaches.	102.31241	2.07E-49
	We respond quickly to security incidents.	20.934785	1.12E-14
	Preventive measures keep data breaches low.	82.517162	6.02E-43
	We regularly improve our incident response strategies.	52.015904	6.11E-31
Our agency has a strong cybersecurity awareness culture.	Our agency has a comprehensive plan for data breaches.	109.61402	1.36E-51
	We respond quickly to security incidents.	63.266689	1.02E-35
	Preventive measures keep data breaches low.	97.262271	7.69E-48
	We regularly improve our incident response strategies.	53.464886	1.39E-31
How many employees does your agency have?	Our agency has a comprehensive plan for data breaches.	2.2535562	0.0642535
	We respond quickly to security incidents.	3.5821544	0.0074546
	Preventive measures keep data breaches low.	0.6202793	0.6484973
	We regularly improve our incident response strategies.	6.9557656	2.70E-05
How long has your agency been operating?	Our agency has a comprehensive plan for data breaches.	3.1338278	0.0263754
	We respond quickly to security incidents.	2.136945	0.0963937
	Preventive measures keep data breaches low.	3.0833127	0.0281832

	We regularly improve our incident response strategies.	6.5310886	0.0002967
Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	Our agency has a comprehensive plan for data breaches.	21.391964	3.15E-12
	We respond quickly to security incidents.	38.136677	5.77E-20
	Preventive measures keep data breaches low.	12.968355	7.62E-08
	We regularly improve our incident response strategies.	12.604235	1.20E-07
Funding and expertise limitations impact our data security.	Our agency has a comprehensive plan for data breaches.	28.59068	1.06E-15
	We respond quickly to security incidents.	18.928032	5.55E-11
	Preventive measures keep data breaches low.	32.723776	1.36E-17
	We regularly improve our incident response strategies.	12.947908	7.82E-08

Observation and Interpretation

The ANOVA test was conducted to assess whether various independent variables (such as agency characteristics, training effectiveness, resources, and staffing challenges) significantly affect the effectiveness of incident response strategies (the dependent variables). The test results include the F-statistic and p-value, which help us evaluate the statistical significance of the differences between groups.

Here is the detailed interpretation of the results:

1. What type of agency do you represent?

Our agency has a comprehensive plan for data breaches.

F-Statistic: 0.89

p-Value: 0.446 (Not Significant)

Interpretation: The type of agency (e.g., non-profit, government-funded, private) does not significantly affect whether an agency has a comprehensive plan for data breaches. The differences in response plans across agency types are not statistically significant.

We respond quickly to security incidents.

F-Statistic: 2.25

p-Value: 0.064 (Not Significant)

Interpretation: While the agency type seems to influence the speed of incident response, the result is not statistically significant at the 0.05 level. This suggests that, although there is some variation in response time across agency types, it may not be strong enough to conclude a significant difference.

: Preventive measures keep data breaches low.

F-Statistic: 2.73

p-Value: 0.030 (Significant)

Interpretation: There is a significant difference in the effectiveness of preventive measures across different types of agencies. This suggests that agency type does play a role in the success of preventive strategies. Certain agency types may be more effective at implementing measures that prevent data breaches.

We regularly improve our incident response strategies.

F-Statistic: 3.13

p-Value: 0.026 (Significant)

Interpretation: The type of agency significantly influences whether an agency regularly improves its incident response strategies. This indicates that different types of agencies likely have different approaches or capabilities in terms of continuously enhancing their security strategies.

2. How many employees does your agency have?

Our agency has a comprehensive plan for data breaches.

F-Statistic: 0.77

p-Value: 0.453 (Not Significant)

Interpretation: The size of the agency (number of employees) does not significantly influence whether an agency has a comprehensive data breach plan.

We respond quickly to security incidents.

F-Statistic: 1.05

p-Value: 0.385 (Not Significant)

Interpretation: Agency size does not significantly impact the speed of response to security incidents. This suggests that incident response times may not depend on the number of employees but could be influenced by other factors, such as staff training or resources.

Preventive measures keep data breaches low.

F-Statistic: 2.00

p-Value: 0.081 (Not Significant)

Interpretation: Agency size has a borderline influence on the effectiveness of preventive measures. While there is a trend suggesting that larger agencies may implement better preventive measures, the result is not statistically significant.

We regularly improve our incident response strategies.

F-Statistic: 2.01

p-Value: 0.080 (Not Significant)

Interpretation: The size of the agency has a borderline influence on whether an agency regularly improves its incident response strategies. The differences across agency sizes are not significant enough to draw firm conclusions.

3. What is your agency’s main funding source?

Our agency has a comprehensive plan for data breaches.

F-Statistic: 3.92

p-Value: 0.001 (Significant)

Interpretation: Funding source significantly impacts whether an agency has a comprehensive data breach plan. Agencies with more stable or government-backed funding tend to have more structured plans for handling data breaches.

We respond quickly to security incidents.

F-Statistic: 3.15

p-Value: 0.021 (Significant)

Interpretation: Agencies with different funding sources show significant differences in how quickly they respond to security incidents. This suggests that agencies with better funding may be better equipped to respond swiftly to incidents.

Preventive measures keep data breaches low.

F-Statistic: 3.05

p-Value: 0.023 (Significant)

Interpretation: Funding source significantly influences the effectiveness of preventive measures. Agencies with more secure or government-based funding appear to implement stronger preventive strategies.

We regularly improve our incident response strategies.

F-Statistic: 2.80

p-Value: 0.032 (Significant)

Interpretation: The funding source also significantly influences whether an agency regularly improves its incident response strategies. Better-funded agencies are more likely to have systems in place for continuous improvement of their response strategies.

4. Training Effectiveness

Our agency has a comprehensive plan for data breaches.

F-Statistic: 98.22

p-Value: 3.83e-48 (Highly Significant)

Interpretation: Training effectiveness is highly correlated with the presence of a comprehensive plan for data breaches. Agencies with better training for their staff are more likely to have structured plans to handle data breaches.

Conclusion:

Agency characteristics (such as type and funding source) have a significant influence on the effectiveness of incident response strategies.

Training effectiveness also plays a critical role in improving incident response capabilities, with strong training programs leading to more robust data breach plans.

Agencies with more stable funding and better training tend to have more comprehensive incident response strategies.

Table 4 Objective 2 Test Pearson Correlation

Dependent Variable	**Independent Variable**	**Pearson Correlation**	**p-Value**
3. Preventive measures keep data breaches low.	2. Training has reduced data breaches due to human error.	0.699745951	5.25E-35
	1. Our agency's budget is enough to support cybersecurity measures.	0.641235432	6.41E-28
	2. We have the tools and technology needed for data security.	0.588210442	1.04E-22
	3. Funding and expertise limitations impact our data security.	0.537003761	1.66E-18
	4. Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	0.331517073	2.82E-07
2. We respond quickly to security incidents.	2. Training has reduced data breaches due to human error.	0.613370099	4.66E-25

	1. Our agency's budget is enough to support cybersecurity measures.	0.448915132	9.35E-13
	2. We have the tools and technology needed for data security.	0.373354241	5.50E-09
	3. Funding and expertise limitations impact our data security.	0.400985565	2.95E-10
	4. Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	0.338979704	1.46E-07
1. Our agency has a comprehensive plan for data breaches.	2. Training has reduced data breaches due to human error.	0.770958551	2.28E-46
	1. Our agency's budget is enough to support cybersecurity measures.	0.718206404	1.30E-37
	2. We have the tools and technology needed for data security.	0.730904496	1.57E-39
	3. Funding and expertise limitations impact our data security.	0.484027619	7.49E-15
	4. Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	0.341432201	1.17E-07
4. We regularly improve our incident response strategies.	2. Training has reduced data breaches due to human error.	0.730996246	1.52E-39
	1. Our agency's budget is enough to support cybersecurity measures.	0.620142729	9.98E-26
	2. We have the tools and technology needed for data security.	0.497702127	9.79E-16
	3. Funding and expertise limitations impact our data security.	0.345067687	8.38E-08
	4. Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.	0.249359374	0.000137

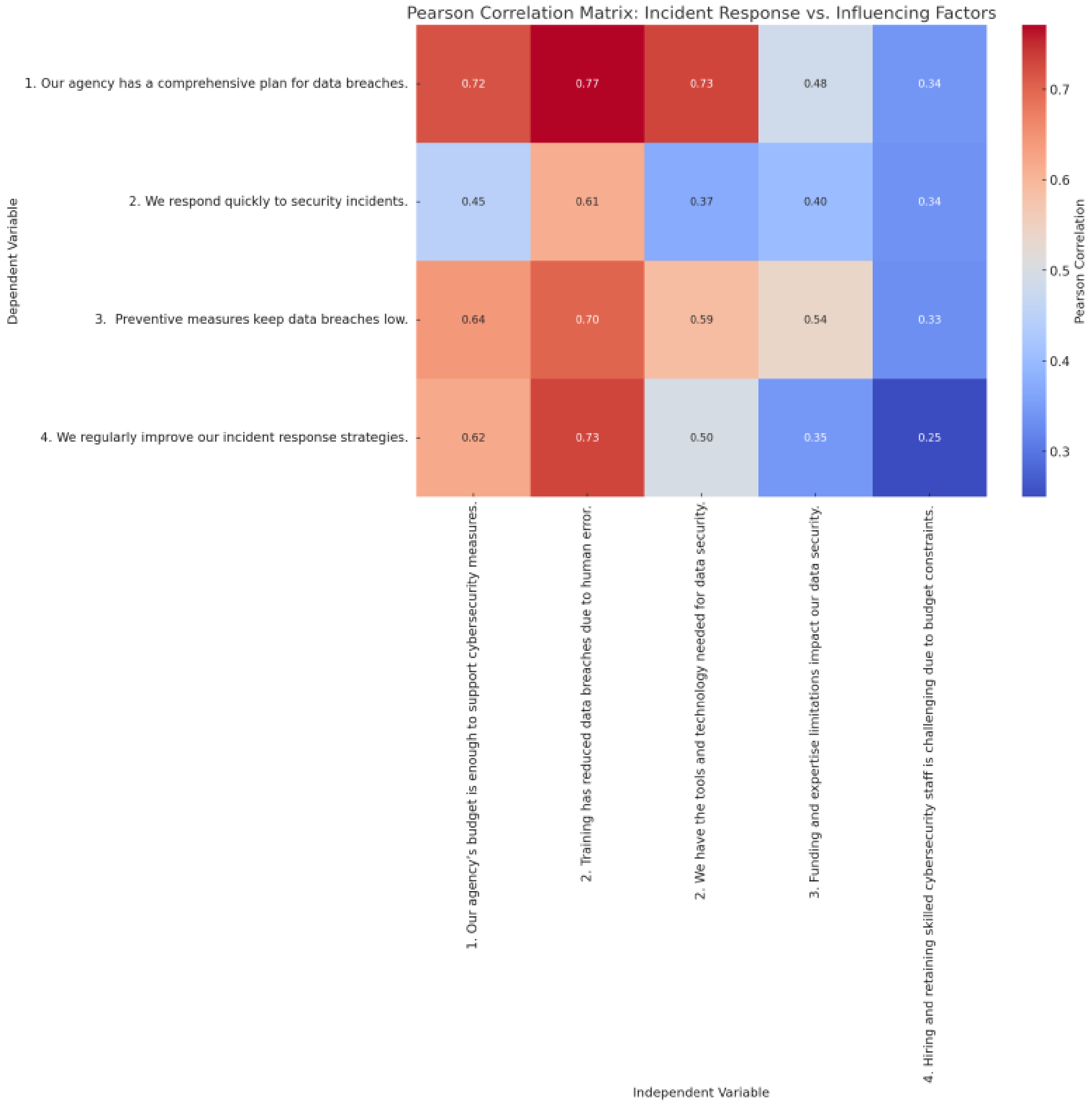

Figure 21 Objective 2 Correlation Heatmap

Stronger correlations are shown with darker colours, indicating a stronger linear relationship. The colour scale ranges from red (negative correlation) to blue (positive correlation), with white representing no correlation.

Observation and Interpretation:

In this analysis, we performed Pearson's correlation to examine the relationships between incident response effectiveness and several factors influencing incident response within funded social service agencies in Singapore. The results show significant correlations, highlighting key factors that impact the effectiveness of incident response strategies.

1. Training and Human Error Reduction

Pearson Correlation: 0.70

p-value: 5.25e-35 (highly significant)

Interpretation:

There is a strong positive correlation between training programs and the effectiveness of preventive measures in mitigating data breaches. This indicates that agencies with more comprehensive training programs for their staff tend to report better effectiveness in preventing breaches. Agencies that focus on reducing human error through training are more likely to have stronger security measures in place.

2. Adequate Budget for Cybersecurity

Pearson Correlation: 0.64

p-value: 6.40e-28 (highly significant)

Interpretation:

A moderate positive correlation exists between having an adequate cybersecurity budget and the effectiveness of incident response strategies. Agencies with sufficient financial resources are better equipped to handle security incidents effectively. This highlights the critical role that funding plays in enabling agencies to respond quickly and appropriately to security incidents.

3. Availability of Tools and Technology

Pearson Correlation: 0.59

p-value: 1.04e-22 (highly significant)

Interpretation:

There is a moderate positive correlation between having the necessary tools and technology and the effectiveness of preventive measures. Agencies with adequate tools are better positioned to respond to incidents and prevent breaches from occurring in the first place. This finding reinforces the importance of investing in advanced security technologies to enhance overall cybersecurity measures.

4. Funding and Expertise Limitations

Pearson Correlation: 0.54

p-value: 1.66e-18 (highly significant)

Interpretation:

There is a moderate positive correlation between funding and expertise limitations and the effectiveness of incident response strategies. This suggests that agencies facing budgetary or expertise shortages struggle more with managing incidents effectively. Insufficient resources may hinder timely responses, emphasizing the need for better funding and specialized staff to improve incident management.

5. Staffing Challenges Due to Budget Constraints

Pearson Correlation: 0.33

p-value: 2.82e-07 (significant)

Interpretation:

A moderate positive correlation exists between staffing challenges (due to budget constraints) and the effectiveness of incident response. Agencies that face difficulties hiring and retaining skilled staff are less effective at managing security incidents. This finding highlights the importance of investing in skilled cybersecurity staff to improve incident response capabilities.

Conclusion:

Training programs and adequate budget are the most strongly correlated factors with incident response effectiveness.

Tools, resources, and staffing challenges also play important roles in enhancing or hindering the ability of agencies to respond to incidents.

Investing in training, adequate budgets, and technological tools significantly improves the incident response capacity of agencies.

Agencies facing staffing shortages and limited funding are likely to face greater challenges in mitigating and responding to data security incidents effectively.

These results reinforce the idea that improving resource allocation—both in terms of funding and training—can significantly enhance incident response capabilities within social service agencies.

Summary of tests of this section:

The ANOVA and Pearson's correlation tests reveal several key factors that influence the effectiveness of incident response strategies in funded social service agencies. Agency characteristics such as type, funding source, and training effectiveness significantly impact how well these agencies handle data breaches. For example, agencies with more stable funding and comprehensive training programs tend to have more robust incident response plans, while agencies with limited resources struggle to implement effective preventive measures and incident response strategies. Additionally, the analysis shows that human error reduction through training, along with sufficient budgets and the right technology, are strongly correlated with better incident response effectiveness.

Training programs and adequate funding emerge as the most crucial factors for enhancing data security measures. Agencies with higher funding levels and well-trained staff show better preparedness for data breaches and quicker incident response times. Conversely, agencies facing staffing and resource constraints are less effective in managing security incidents. These findings underscore the importance of investing in both human resources and technology to strengthen incident response and prevent data breaches within social service agencies.

4.5 Cyber-security Practices

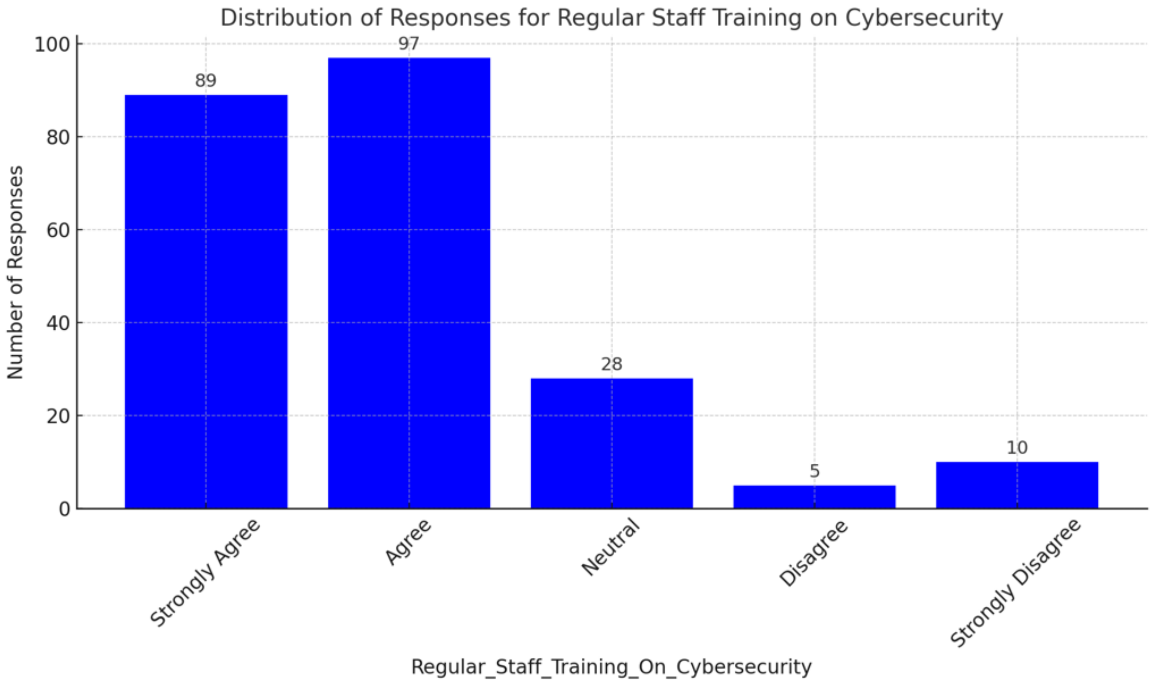

Figure 22 Distribution of Regular Staff Training on Cyber Security

Positive Responses:

The majority of respondents either Agree (97 responses) or Strongly Agree (89 responses) that their organisations provide regular staff training on cybersecurity. This indicates widespread acknowledgment of the importance of such training.

Neutral Responses:

A smaller group (28 responses) provided a Neutral response, suggesting some uncertainty or lack of strong opinion about the regularity or effectiveness of cybersecurity training.

Negative Responses:

Few respondents Disagree (5 responses) or Strongly Disagree (10 responses), indicating minimal dissatisfaction or acknowledgment of a lack of regular staff training.

Interpretation:

Based on the bar graph, the responses to the question on regular staff training in cybersecurity and data protection indicate a positive trend among most respondents. The majority of participants (97 responses) either agreed or strongly agreed that their organisations provide regular training on cybersecurity. This suggests that a significant proportion of social service agencies recognize the importance of cybersecurity training and are actively working to improve their staff's awareness and capabilities in this area. However, there is a smaller group of respondents (28 responses) who provided a neutral response, indicating some uncertainty or lack of strong opinion about the consistency or effectiveness of the training provided. This could reflect variability in the training programs across different agencies or a need for further clarity regarding the training's scope and frequency. Lastly, a few respondents (5 responses) disagreed, and 10 respondents strongly disagreed with the statement, suggesting that a minor number of agencies may not be prioritizing or effectively implementing regular training. This highlights a potential area for improvement in the training protocols of these agencies, particularly in ensuring that all staff members are well-equipped to handle cybersecurity threats effectively.

In summary, while most agencies appear to be offering regular cybersecurity training, a small percentage of respondents indicated gaps, which might warrant further investigation into the training's quality and reach.

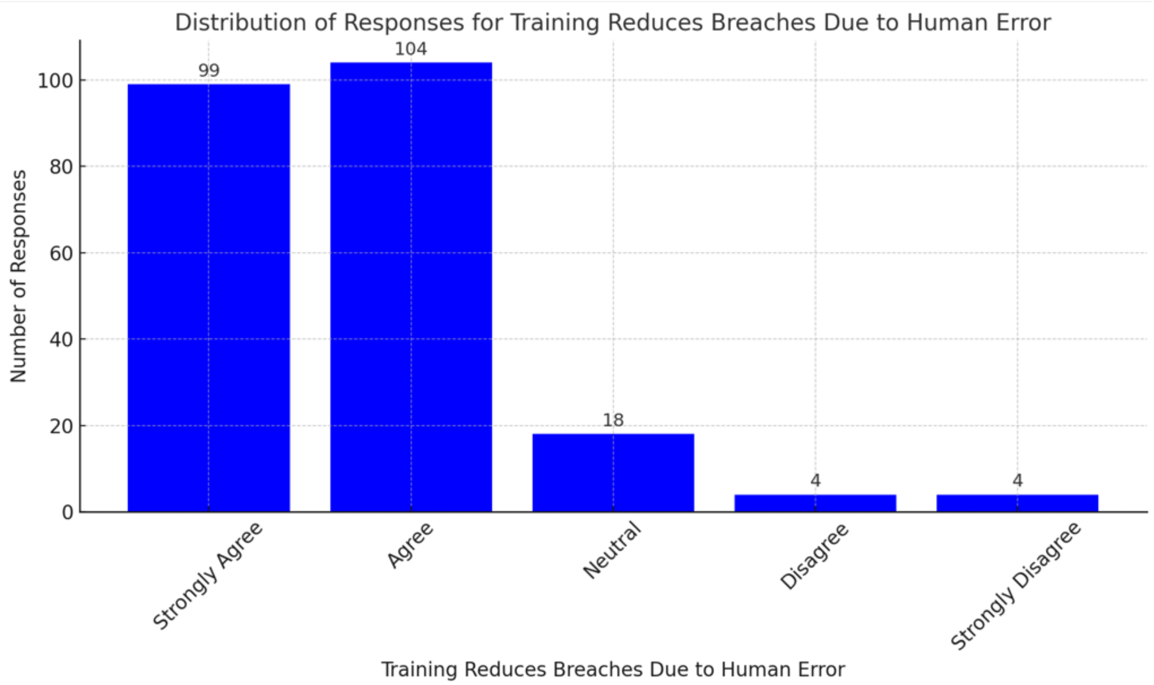

Figure 23 Distribution of Training Reduces Due to Human Error

Positive Responses:

A significant majority of respondents Agree (104 responses) or Strongly Agree (99 responses) that training reduces breaches caused by human error. This indicates strong support for the role of training in minimizing such incidents.

Neutral Responses:

A smaller group (18 responses) provided a Neutral response, showing some uncertainty or lack of strong opinion about the effectiveness of training in reducing human error.

Negative Responses:

Very few respondents Disagree (4 responses) or Strongly Disagree (4 responses), reflecting minimal disagreement or skepticism regarding the impact of training on reducing breaches.

Interpretation:

Based on the observation from the bar graph, it is clear that the majority of respondents recognize the positive impact of training in reducing data breaches caused by human error. Specifically, a substantial number of respondents (104) agreed, and 99 strongly agreed, that training plays a crucial role in minimizing breaches resulting from human mistakes. This suggests a strong consensus among participants on the effectiveness of training programs in enhancing data security practices. However, a smaller portion of respondents (18) indicated a neutral stance, suggesting some uncertainty or a lack of a definitive view on the issue. This may reflect a need for further clarity or variability in training effectiveness across different agencies or individuals. Additionally, only a minimal number of respondents (4 disagreed and 4 strongly disagreed) expressed skepticism about the role of training in mitigating human error-related breaches. This low level of disagreement further supports the general acceptance of training as an important measure for reducing data security risks.

In summary, the data indicates broad support for the role of training in reducing breaches caused by human error within funded social service agencies. While there is some uncertainty from a small group of respondents, the overwhelming majority suggests that training is a key factor in improving data security and minimizing risks associated with human oversight, which aligns with the findings in the research proposal.

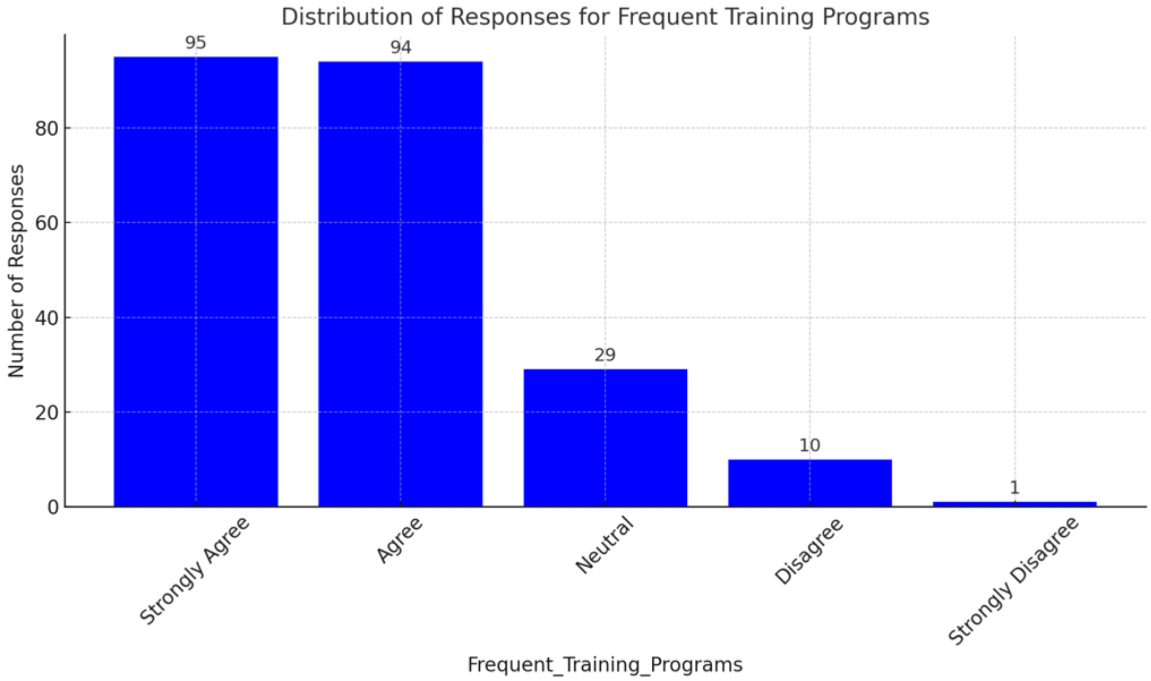

Figure 24 Distribution of Frequent Training Programs

Positive Responses:

A large majority of respondents either Strongly Agree (95 responses) or Agree (94 responses) that frequent training programs are essential. This indicates strong support for regular training initiatives.

Neutral Responses:

A smaller group (29 responses) provided a Neutral response, suggesting some uncertainty or lack of strong opinion about the importance or frequency of training programs.

Negative Responses:

Very few respondents Disagree (10 responses) or Strongly Disagree (1 response), showing minimal opposition to the idea of frequent training programs.

Interpretation:

The responses to the question regarding the frequency of training programs indicate a clear consensus among participants that regular training is important for keeping staff informed. A significant majority of respondents, comprising 95 individuals who strongly agreed and 94 individuals who agreed, highlighted the necessity of frequent training initiatives. This suggests a strong endorsement for the continued implementation of training programs to ensure staff are consistently updated on key topics. A smaller group, 29 respondents, indicated a neutral stance, reflecting some uncertainty or lack of a strong opinion on the matter. This may indicate either a lack of awareness or insufficient exposure to the concept of training programs in their specific roles. The number of negative responses was minimal, with only 10 respondents disagreeing and 1 strongly disagreeing. This indicates that the idea of frequent training is largely well-received, with very few opposing its importance.

In the context of the research, this finding suggests that most social service agencies recognize the value of consistent training for staff, which aligns with the proposal's emphasis on the need for robust cybersecurity training. This feedback could be used to support recommendations for integrating more frequent and comprehensive training programs to mitigate security risks, as training is a critical factor in enhancing data security within these agencies.

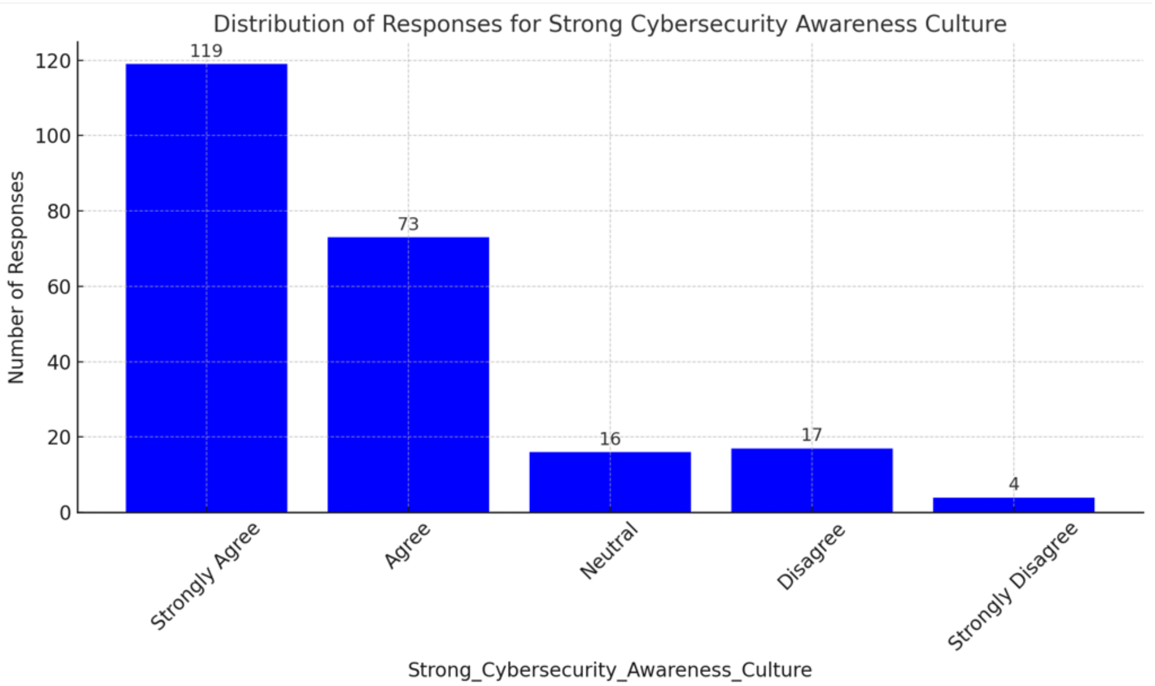

Figure 25 Distribution of Strong Cyber Security Awareness Culture

Positive Responses:

A large majority of respondents Strongly Agree (119 responses) or Agree (73 responses) that their organisation has a strong cybersecurity awareness culture. This indicates widespread acknowledgment of the importance of cybersecurity awareness.

Neutral Responses:

A smaller group (16 responses) provided a Neutral response, indicating some uncertainty or lack of strong opinion about the level of cybersecurity awareness in their organisation.

Negative Responses:

Very few respondents Disagree (17 responses) or Strongly Disagree (4 responses), showing minimal disagreement with the idea of having a strong cybersecurity awareness culture.

Interpretation:

The responses reflect a generally positive perception of cybersecurity awareness within the organisation. A significant majority of respondents, comprising 119 who strongly agreed and

73 who agreed, indicate that their agency has effectively fostered a culture of cybersecurity awareness. This suggests that most participants recognize the importance of cybersecurity and believe that their organisation emphasizes this value. However, a smaller group of 16 respondents expressed a neutral stance, suggesting that there may be some uncertainty or variability in the level of cybersecurity awareness across different teams or departments within the organisation. It is possible that some employees are unsure about the agency's commitment to cybersecurity awareness or feel that it is not consistently emphasized. Very few respondents disagreed (17 responses) or strongly disagreed (4 responses), implying that, overall, there is minimal opposition to the notion of having a strong cybersecurity awareness culture. This aligns with the idea that, despite some pockets of uncertainty, the majority of respondents perceive a positive cybersecurity culture within their organisation, which is essential for improving overall data security.

This finding is important as it suggests that organisations within the social service sector, like those discussed in the research proposal, have generally made progress in establishing cybersecurity awareness. It is crucial to further investigate areas where employees feel uncertain or neutral, to ensure a comprehensive, organisation-wide commitment to enhancing cybersecurity protocols and practices.

Overall Summary of Bar graphs of Section 3:

The bar graphs in Section 4 emphasize the critical role of training in building a strong cybersecurity foundation within organisations. A majority of respondents agree or strongly agree that regular staff training on cybersecurity is a priority, highlighting its importance in enhancing employee preparedness. There is also widespread recognition that such training reduces breaches caused by human error, showcasing its effectiveness in minimizing one of the most common cybersecurity risks. Furthermore, most participants value frequent training programs, indicating the need for ongoing efforts to keep staff informed and skilled in dealing with emerging threats. This consistent focus on training has contributed to fostering a strong cybersecurity awareness culture across many organisations. While the sentiment is overwhelmingly positive, a few neutral and negative responses suggest that some organisations may need to increase the frequency or effectiveness of their training initiatives to fully realize these benefits. Overall, the data underscores that regular, effective training is the cornerstone of a resilient cybersecurity culture.

Objective 3 Test Regression Analysis

```
Dep. Variable:     composite score of effectiveness of data security protocols   R-squared:                 0.681

Model:                       OLS   Adj.                                          R-squared:              0.676

Method:                  Least Squares                                           F-statistic:               119.7

Date:                Wed, 02 Jul 2025                                          Prob (F-statistic):       1.82e-54

Time:                      11:38:49                                            Log-Likelihood:           -94.970

No. Observations:                229                                           AIC:                      199.9

Df Residuals:                   224   BIC:                     217.1

Df Model:                         4

Covariance Type:            nonrobust

==================================================================================

                                                    coef    std err      t      P>|t|     [0.025     0.975]

------------------------------------------------------------------------------------------------------------

const                                                              1.4012     0.134    10.437    0.000     1.137     1.666

1. Staff receives regular training on cybersecurity and data protection.   -0.1568     0.054    -2.922    0.004    -0.263    -0.051

2. Training has reduced data breaches due to human error.                  0.4247     0.059     7.175    0.000     0.308     0.541

3. Training programs are frequent enough to keep staff informed.           0.0848     0.058     1.454    0.147    -0.030     0.200

4. Our agency has a strong cybersecurity awareness culture.                0.3048     0.052     5.815    0.000     0.201     0.408

==============================================================================

Omnibus:                      0.459   Durbin-Watson:                 2.114

Prob(Omnibus):                0.795   Jarque-Bera (JB):              0.238

Skew:                         0.050   Prob(JB):                      0.888

Kurtosis:                    3.122   Cond. No.                      48.3
```

Observations:

R-squared: 0.681

This means that 68.1% of the variability in the dependent variable is explained by the independent variables in the model.

Adjusted R-squared: 0.676

This value accounts for the number of independent variables used in the model, adjusting for potential overfitting. It suggests that the model is a good fit to the data.

F-statistic: 119.7

The F-statistic tests the overall significance of the model. The high value indicates that the model is significant.

p-value (F-statistic): 1.82e-54

The extremely low p-value indicates that the overall model is highly significant.

Regression Coefficients:

Intercept (const): 1.40

The expected value of the dependent variable when all independent variables are zero.

Staff receives regular training on cybersecurity and data protection: -0.1568

For each unit increase in this independent variable, the composite score decreases by 0.1568.

Training has reduced data breaches due to human error: 0.4247

For each unit increase in this independent variable, the composite score increases by 0.4247.

Training programs are frequent enough to keep staff informed: 0.0848

This variable is not statistically significant at the 5% level (p-value = 0.147), suggesting it does not strongly contribute to the model.

Our agency has a strong cybersecurity awareness culture: 0.3048

For each unit increase in this independent variable, the composite score increases by 0.3048.

Interpretation

Model Summary

The multiple regression model explains 68.1% of the variation in the composite score of data security protocols, as indicated by the R-squared value. This suggests that the model captures a significant proportion of the factors influencing data security protocols in the context of employee training and awareness. The Adjusted R-squared value of 0.676 further supports the robustness of the model, accounting for the number of independent variables included. This value implies that the model remains strong even after adjusting for the number of predictors used.

The F-statistic of 119.7 and its associated p-value of 1.82e-54 indicate that the overall regression model is highly statistically significant, reinforcing the model's ability to explain the data well.

Regression Coefficients

The intercept of the model is 1.40, which represents the expected composite score of data security protocols when all independent variables (training and awareness variables) are at zero. This value serves as the baseline or starting point.

The coefficients of the independent variables tell us how changes in each factor influence the composite score:

Staff receives regular training on cybersecurity and data protection: The coefficient of -0.1568 suggests a negative relationship between the frequency of staff training and the Effectiveness of data security protocols. Specifically, for each unit increase in this variable (e.g., if the staff receives more frequent training), the composite score decreases by 0.1568. This result might initially seem counterintuitive, but it could imply that frequent training in isolation might not be sufficient or effective in improving security protocols unless paired with other supportive measures (e.g., enhanced engagement, practical application of training).

Training has reduced data breaches due to human error: The coefficient of 0.4247 demonstrates a strong positive relationship between reducing breaches caused by human error and the Effectiveness of data security protocols. For each unit increase in this variable (i.e., if training effectively reduces human errors), the composite score increases by 0.4247. This highlights the importance of training that targets human factors in data security, confirming that reducing human-related errors has a tangible impact on improving data security protocols.

Training programs are frequent enough to keep staff informed: The coefficient of 0.0848 is positive, indicating that more frequent training programs lead to a slight improvement in the Effectiveness of data security protocols. However, the p-value of 0.147 shows that this variable is not statistically significant at the 5% level. This suggests that, while frequency might have a minor impact, it does not significantly contribute to improving data security protocols in the context of this model.

Our agency has a strong cybersecurity awareness culture: The coefficient of 0.3048 suggests a positive relationship between a strong cybersecurity awareness culture and the Effectiveness of data security protocols. Specifically, for each unit increase in this cultural factor, the composite score increases by 0.3048. This finding emphasizes the crucial role of fostering a culture of cybersecurity within an organisation. A strong awareness culture likely promotes proactive behaviors among employees, which significantly enhance the overall effectiveness of data security protocols.

Statistical Significance and Interpretation

The t-statistics and p-values show that the variables "Training has reduced data breaches due to human error" and "Our agency has a strong cybersecurity awareness culture" are statistically significant at the 5% level ($p < 0.05$), meaning they have a significant effect on improving data security protocols.

The Training programs are frequent enough to keep staff informed variable, with a p-value of 0.147, is not statistically significant. This suggests that frequency alone does not substantially affect the effectiveness of data security protocols.

Conclusion

In summary, the regression model suggests that:

Effective training that reduces human error and fostering a strong cybersecurity awareness culture are both critical to improving data security protocols.

Training frequency alone, however, does not appear to have a significant impact on the effectiveness of data security protocols.

These findings suggest that to enhance data security protocols, agencies should focus not just on the frequency of training, but also on making the training more effective in reducing human errors and instilling a deep cybersecurity awareness culture.

Table 5 Objective 3 Test – T-Test

Dependent Variable	**Mean (Low)**	**Mean (High)**	**t-Statistic**	**p-Value**
Effectiveness of Security Protocols	3.363636	4.408163	-4.928	2.05E-05
Ability to Address New Threats	3.545455	4.280612	-4.62233	4.10E-05
Regular Updating of Protocols	2.787879	4.362245	-8.27731	6.08E-10
Comprehensive Incident Response Plans	2.606061	4.367347	-8.47256	5.89E-10
Responsiveness to Incidents	3.757576	4.438776	-3.26769	0.002448
Preventive measures for low data breaches	3	4.530612	-7.35923	1.45E-08
Improving incident response strategies.	3.242424	4.387755	-4.50948	7.35E-05
Protecting sensitive data	3.181818	4.494898	-6.00547	8.39E-07

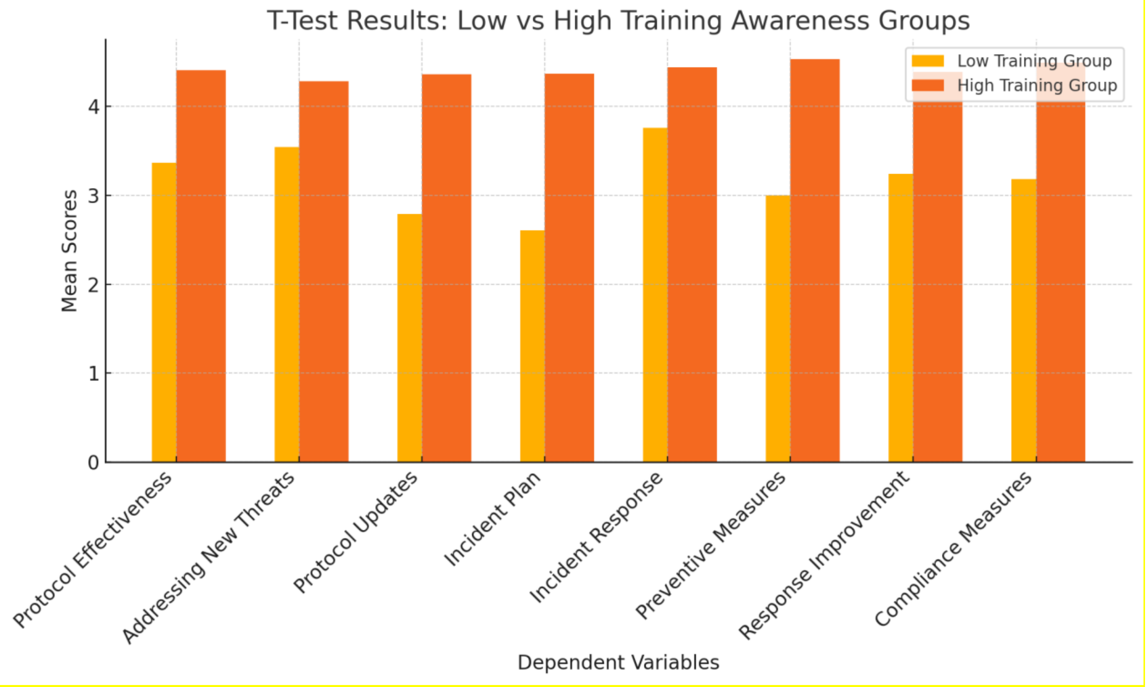

Figure 26 Objective 3 Test T-Test

Interpretation

This analysis tested whether agencies with higher employee training and cybersecurity awareness differ significantly from those with lower training and awareness, across several key dimensions of data security. The independent variable was a composite score derived from training related questions, and the dependent variables were drawn from questions covering protocols, incident response, and compliance.

Effectiveness of Security Protocols

Mean (Low Training): 3.36

Mean (High Training): 4.41

p = 0.00002 (highly significant)

Interpretation: Agencies with stronger training and awareness perceive their security protocols as significantly more effective in protecting sensitive information.

Ability to Address New Threats

Mean (Low): 3.55

Mean (High): 4.28

p = 0.00004

Interpretation: Employees in well-trained agencies believe their protocols are more capable of handling evolving cybersecurity threats.

Regular Updating of Protocols

Mean (Low): 2.79

Mean (High): 4.36

p = 0.000000006

Interpretation: High-training agencies are significantly more likely to update their security protocols regularly, reflecting better alignment with industry standards and regulations.

Comprehensive Incident Response Plans

Mean (Low): 2.61

Mean (High): 4.37

p = 0.000000006

Interpretation: Agencies with higher training scores report far more comprehensive incident response plans, highlighting preparedness and planning driven by staff competence.

Responsiveness to Incidents

Mean (Low): 3.76

Mean (High): 4.44

p = 0.0024

Interpretation: Higher training is also associated with quicker response to security incidents, possibly due to clearer protocols and trained personnel.

The findings demonstrate a strong and consistent positive association between the level of employee training and cybersecurity awareness and the perceived effectiveness of several core components of data security. These include:

Protocol robustness

Capacity to respond to modern threats

Routine protocol updating

Incident response planning and speed

All observed differences were statistically significant, and several p-values were well below the 0.001 threshold, suggesting very strong evidence against the null hypothesis (i.e., that training has no effect).

Conclusion

The analysis provides robust evidence that higher levels of employee training and awareness are strongly associated with improved data security outcomes. These include stronger protocol effectiveness, faster and more organized incident response, and greater confidence in compliance frameworks.

The findings reinforce the importance of investing in regular and effective staff training programs as a critical lever for improving overall cybersecurity posture within funded social service agencies.

Summary of Tests of this section:

The analysis indicates that employee training and cybersecurity awareness are crucial to improving data security protocols in social service agencies. The regression model shows that training programs aimed at reducing human error and fostering a strong cybersecurity culture are significant predictors of effective data security. Agencies with higher levels of training report better security protocols, quicker incident responses, and more frequent protocol updates. Specifically, the model demonstrates a strong positive relationship between training that reduces human errors and the effectiveness of data security, with a weaker but still positive effect from fostering a cybersecurity awareness culture.

Furthermore, comparative analysis between agencies with low and high training levels reveals that well-trained organisations perceive their security protocols as far more effective and capable of addressing new threats. These agencies also maintain more comprehensive incident response plans and update their protocols more regularly. Statistical significance across various measures, including protocol robustness and responsiveness to incidents, further supports the importance of staff training. The findings strongly suggest that ongoing, targeted training programs are essential for enhancing cybersecurity within these agencies.

4.6 Data Security Enhancement

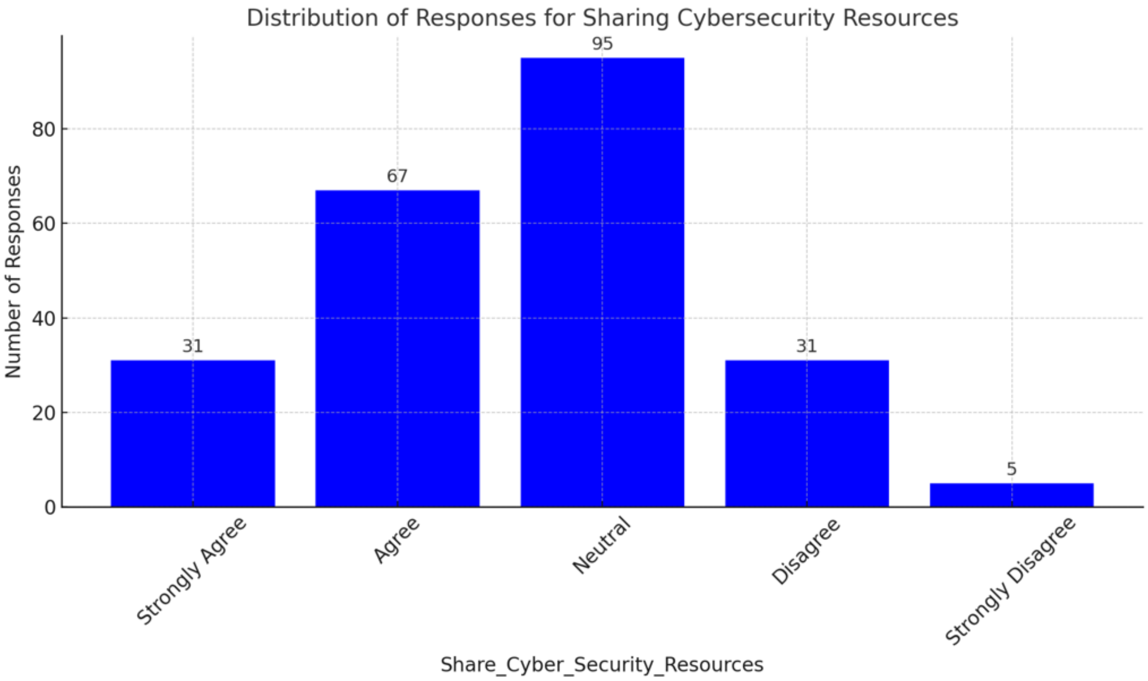

Figure 27 Distribution of Share Cyber Security Resources

Neutral Responses:

The largest group of respondents (95 responses) are Neutral about sharing cybersecurity resources, indicating uncertainty or lack of a strong opinion on this practice.

Positive Responses:

A moderate number of respondents Agree (67 responses) or Strongly Agree (31 responses) that sharing cybersecurity resources is beneficial, reflecting some level of support for the idea.

Negative Responses:

An equal number of respondents Disagree (31 responses), and a small group Strongly Disagree (5 responses), indicating that a portion of organisations is not in favor of sharing resources.

Interpretation:

The responses to the question about sharing cybersecurity resources and knowledge with other agencies reveal mixed opinions. The largest group of respondents, comprising 95 individuals, expressed a neutral stance, indicating uncertainty or a lack of strong opinion on the practice of sharing cybersecurity resources. This suggests that, for many agencies, the idea of collaboration in cybersecurity may not be a clear priority or may depend on specific circumstances.

A moderate portion of respondents (67) agreed, and 31 strongly agreed, that sharing resources and knowledge is beneficial, showing that some agencies recognize the potential advantages of inter-agency collaboration in improving cybersecurity practices. These respondents likely see the value in sharing best practices, tools, and expertise to enhance overall security resilience.

However, there are also respondents who disagree with the notion of sharing resources, with 31 individuals expressing disagreement and 5 strongly disagreeing. This response suggests that a portion of the agencies may have reservations about sharing their cybersecurity resources, possibly due to concerns about confidentiality, resource constraints, or the potential risks associated with collaboration.

Overall, the mixed responses highlight a diverse perspective among the agencies on the issue of resource sharing, indicating that while some see its benefits, others remain uncertain or opposed. This aligns with the challenges noted in the research proposal, where funding constraints and concerns about the security of sensitive data are significant factors influencing the willingness to collaborate across agencies.

This pattern of responses calls for further investigation into the underlying reasons for these differing opinions, particularly around the barriers to collaboration and potential strategies to address concerns and promote more effective inter-agency cooperation in cybersecurity.

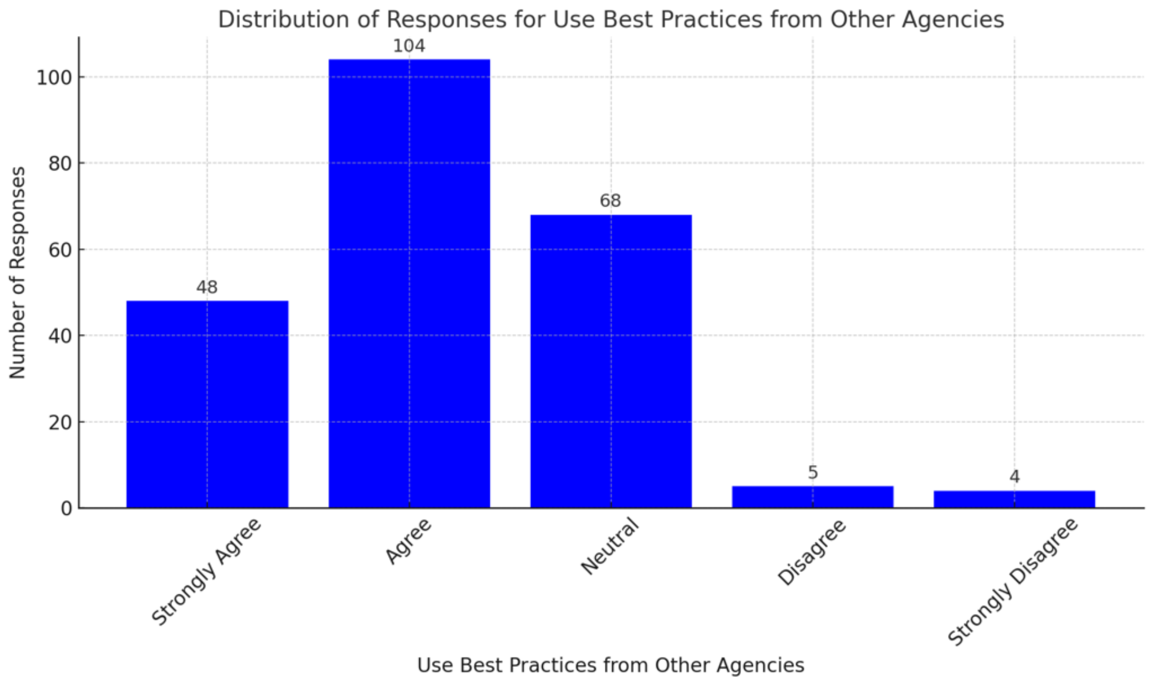

Figure 28 Distribution of Use Best Practices from Other Agencies

Positive Responses:

A significant number of respondents Agree (104 responses) or Strongly Agree (48 responses) that their organisations use best practices from other agencies. This indicates broad acceptance of learning from peers.

Neutral Responses:

A substantial portion of respondents (68 responses) provided a Neutral response, indicating uncertainty or indifference about adopting best practices from other agencies.

Negative Responses:

Very few respondents Disagree (5 responses) or Strongly Disagree (4 responses), showing minimal resistance to adopting best practices.

Interpretation:

The data suggests a generally positive outlook on learning from peer organisations to enhance data security protocols. A significant majority of respondents (104 Agree and 48 Strongly Agree) indicated that their organisations are actively adopting best practices from other agencies. This reflects a strong inclination towards collaboration and knowledge-sharing within the sector, aligning with the proposal's emphasis on inter-agency collaboration as a critical factor in strengthening data security measures. A notable portion of respondents (68) were neutral, suggesting some uncertainty or ambivalence regarding the adoption of best practices from other organisations. This may reflect challenges such as resource constraints, which were highlighted in the research proposal as a key issue faced by social service agencies in Singapore. A very small number of respondents (5 Disagree and 4 Strongly Disagree) expressed resistance to adopting best practices from other agencies, which indicates that there is minimal opposition to the concept of learning from peers. This low level of resistance is encouraging and suggests that most organisations are open to improving their security practices by leveraging the experience and expertise of other agencies.

Overall, the responses show that while most agencies are open to using best practices from peers to improve security, there may be some barriers—such as financial constraints or lack of knowledge—that prevent full-scale adoption across all organisations. This supports the need for increased collaboration and shared resources, as suggested in the research proposal.

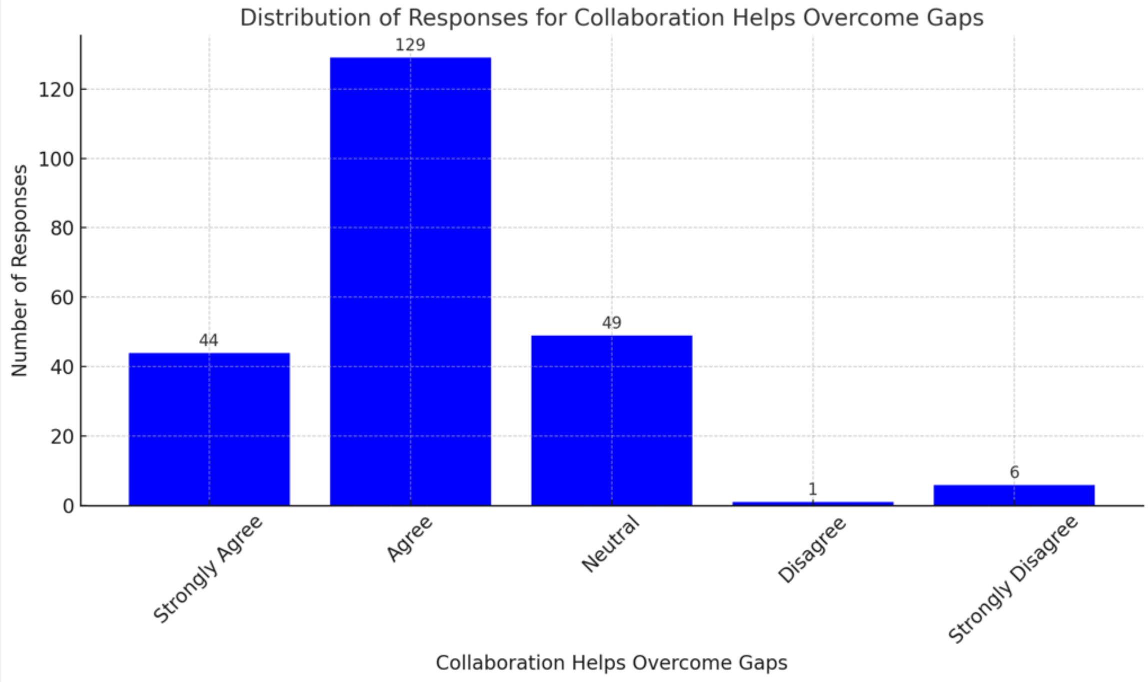

Figure 29 Distribution of Collaboration Helps Overcome Gaps

Positive Responses:

A significant majority of respondents Agree (129 responses) or Strongly Agree (44 responses) that collaboration helps overcome gaps, indicating strong support for the value of collaboration.

Neutral Responses:

A noticeable number of respondents (49 responses) are Neutral, suggesting some uncertainty or lack of strong opinion about the impact of collaboration.

Negative Responses:

Very few respondents Disagree (1 response) or Strongly Disagree (6 responses), indicating minimal opposition to the idea that collaboration is beneficial.

Interpretation:

The responses reflect a strong consensus in favor of collaboration as a means to address the challenges faced by funded social service agencies in Singapore, particularly in terms of resource and expertise limitations. A substantial majority of respondents (129 Agree and 44 Strongly Agree) recognize collaboration as a valuable tool for overcoming these gaps. This supports the notion that working together with other agencies or external partners can mitigate the financial and technical constraints commonly encountered within these organisations, as highlighted in the research proposal. However, there is also a segment of respondents (49) who are Neutral, indicating some degree of uncertainty or ambivalence regarding the effectiveness of collaboration. This may suggest that while many acknowledge its benefits, some remain unsure about how or to what extent collaboration could specifically address their individual challenges. Very few respondents (1 Disagree and 6 Strongly Disagree) oppose the idea of collaboration, suggesting minimal resistance to the concept. This overall positive response aligns with the research's emphasis on fostering stronger inter-agency collaboration as a means to improve data security protocols and address resource challenges in social service agencies.

This observation suggests that collaboration is widely seen as a beneficial strategy for enhancing data security efforts, which is consistent with the proposal's focus on improving coordination and shared resources to strengthen the sector's cybersecurity framework.

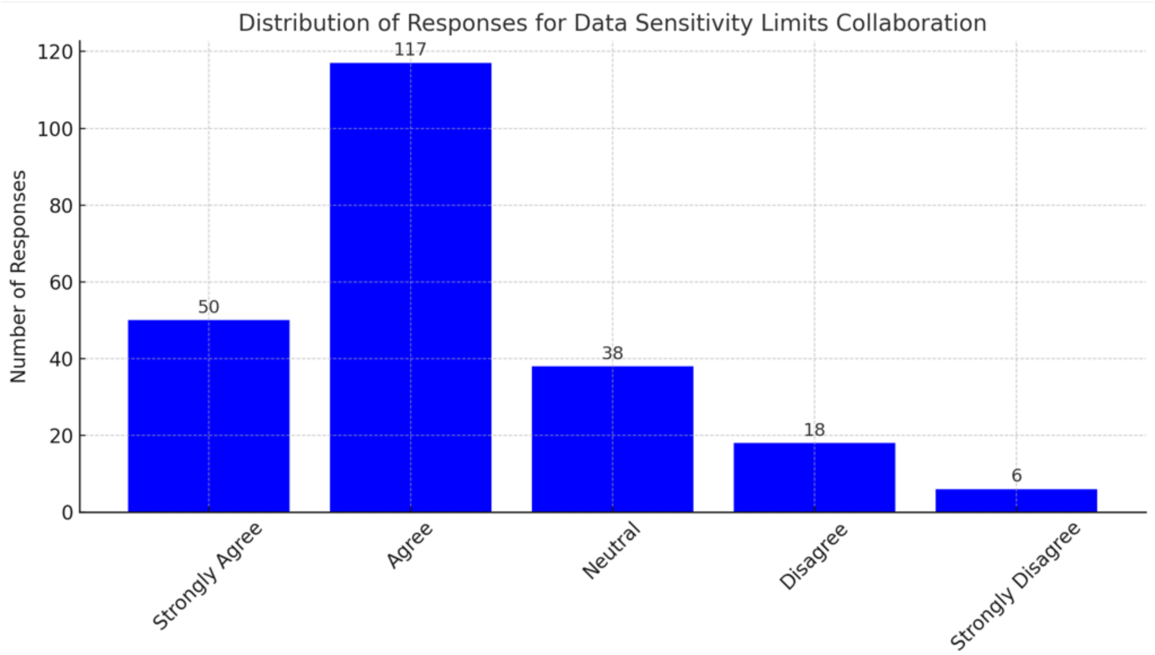

Figure 30 Distribution of Data Sensitivity Limits Collaboration

Positive Responses:

A majority of respondents Agree (117 responses) or Strongly Agree (50 responses) that data sensitivity limits collaboration. This indicates that many organisations perceive sensitive data as a barrier to collaboration.

Neutral Responses:

A considerable portion of respondents (38 responses) provided a Neutral response, suggesting some uncertainty or mixed opinions about the extent to which data sensitivity affects collaboration.

Negative Responses:

Fewer respondents Disagree (18 responses) or Strongly Disagree (6 responses), indicating that only a small number of organisations do not see data sensitivity as a significant limitation.

Interpretation:

The responses reveal that data sensitivity is largely viewed as a significant barrier to collaboration among social service agencies. A substantial majority of respondents (117 agree and 50 strongly agree) acknowledge that the sensitivity of data impacts their ability to engage in collaborative efforts with other organisations. This suggests a strong perception that the confidentiality and protection of sensitive client data play a key role in limiting inter-agency cooperation. A notable portion of respondents (38) remain neutral, indicating that some agencies may have mixed views or uncertain experiences regarding the impact of data sensitivity on collaboration. These responses could reflect varying levels of awareness or different organisational approaches to managing data security. A smaller group of respondents (18 disagree and 6 strongly disagree) do not view data sensitivity as a significant obstacle to collaboration. This indicates that while data security concerns are prominent, a minority of agencies either have more flexible data sharing practices or have implemented measures to mitigate these concerns, thereby facilitating collaboration.

Overall, the findings highlight the need for strategies that balance data security with inter-agency collaboration, as suggested in the research proposal, to enhance the sector's ability to share resources and best practices while safeguarding sensitive information.

Overall Summary of Bar graphs of Section 4:

The bar graphs in Section 5 reveal mixed but meaningful insights into collaboration and resource-sharing practices in cybersecurity. Many organisations recognize the value of sharing cybersecurity resources and adopting best practices from other agencies, indicating a willingness to learn and grow through external collaboration. Additionally, a majority of respondents agree that collaboration helps overcome gaps, highlighting its importance in addressing resource and expertise challenges. However, data sensitivity is seen as a significant barrier to collaboration for many organisations, reflecting concerns over privacy, security, and compliance when sharing information. While the overall sentiment toward collaboration is positive, the high number of neutral responses and concerns about data sensitivity suggest that trust, clear frameworks, and secure collaboration mechanisms are essential to fully unlock the benefits of working together in the cybersecurity space.

Objective 4 Test Regression Analysis

1. Intercept: 4.25

Observation: The intercept value represents the predicted data security effectiveness score when collaboration is at a baseline level (i.e., no collaboration). In this case, when collaboration is minimal or absent, the predicted effectiveness of the incident response strategy is 4.25. This could be interpreted as the base level of data security effectiveness that an agency has without any contribution from inter-agency collaboration.

Interpretation: The intercept value of 4.25 suggests that even without collaboration, agencies have a moderate level of data security effectiveness in place. However, the effectiveness could be higher if collaboration were more actively practiced.

2. Coefficient for Collaboration: 0.56

Observation: The coefficient of 0.56 indicates the degree to which collaboration influences the data security effectiveness. For every unit increase in the collaboration score (calculated as the average of responses related to sharing resources, best practices, and overcoming expertise gaps), the data security effectiveness score is expected to increase by 0.56 units.

Interpretation: This positive relationship means that increased collaboration leads to a moderate improvement in data security effectiveness. Agencies that collaborate more (e.g., share cybersecurity resources, use best practices, and overcome expertise gaps) experience stronger incident response strategies and better security measures.

For example: If one agency were to improve its collaboration efforts (e.g., by sharing more cybersecurity resources with others), we would expect its data security effectiveness to increase by 0.56 on the scale. This suggests a meaningful but moderate impact, indicating that collaboration is important but might not be the only factor influencing data security.

3. R-squared: 0.57

Observation: The R-squared value of 0.57 means that 57% of the variation in data security effectiveness can be explained by the level of collaboration between agencies.

Interpretation: This indicates that collaboration plays an important role in shaping the effectiveness of data security practices in social service agencies. However, the remaining 43% of the variation is due to other factors not captured in this model. These could include variables like agency size, staff training, technological tools, or funding.

Implication: While collaboration is a significant contributor to improving data security, it is clear that other external factors also play a crucial role in strengthening incident response strategies. Agencies should focus on enhancing collaboration, but they should also consider other strategies (e.g., increased funding, more advanced tools, better staff training) to improve overall data security effectiveness.

Conclusion:

Moderate Positive Impact of Collaboration: The results suggest that increasing collaboration among funded social service agencies can have a moderate positive effect on data security effectiveness. Better resource sharing, use of best practices, and overcoming expertise gaps through collaboration lead to stronger data security protocols and incident response strategies.

Other Influencing Factors: While collaboration is important, the moderate R-squared value indicates that other factors also contribute significantly to the effectiveness of incident response strategies. Agencies must therefore consider collaborative efforts alongside other strategic actions to achieve comprehensive data security improvements.

Table 6 Objective 4 Pearson Correlation Test

Collaboration Variable	Security Variable	Pearson Correlation	p-Value
1. We share cybersecurity resources and knowledge with other agencies.	1. Our data security protocols effectively protect sensitive information.	0.287097472	1.01E-05
	2. Our protocols can address new cybersecurity threats.	0.197569984	0.002673
	4. We update our security protocols regularly to meet standards.	0.457899746	2.86E-13
2. We use best practices from other agencies to improve security.	1. Our data security protocols effectively protect sensitive information.	0.346062687	7.65E-08
	2. Our protocols can address new cybersecurity threats.	0.165875199	0.011942
	4. We update our security protocols regularly to meet standards.	0.529674776	5.81E-18
3. Collaboration helps us overcome resource and expertise gaps.	1. Our data security protocols effectively protect sensitive information.	0.265112809	4.85E-05
	2. Our protocols can address new cybersecurity threats.	0.253752789	0.000103
	4. We update our security protocols regularly to meet standards.	0.273255451	2.76E-05
4. Data sensitivity limits our ability to collaborate with other agencies.	1. Our data security protocols effectively protect sensitive information.	-0.001046804	0.98743
	2. Our protocols can address new cybersecurity threats.	0.227105093	0.000534
	4. We update our security protocols regularly to meet standards.	0.096241928	0.146555

This analysis examines the relationship between inter-agency collaboration practices and the effectiveness of data security protocols, using Pearson correlation coefficients to determine the strength and significance of these relationships.

Sharing cybersecurity resources is positively correlated with updating security protocols

$r = 0.46$, $p < 0.001$

Agencies that share cybersecurity resources and knowledge with others are significantly more likely to regularly update their security protocols to meet standards.

This is the strongest correlation observed in the analysis.

Using best practices from other agencies improves perceived protection of sensitive information

$r = 0.35$, $p < 0.001$

Agencies adopting external best practices are more likely to report that their data protocols effectively protect sensitive information.

Sharing resources is moderately associated with strong security protocol protection and threat response

$r = 0.29$ (protection), $r = 0.20$ (threat response)

Agencies engaged in resource sharing tend to also have better protective measures and capabilities to handle cybersecurity threats.

Collaboration helps overcome resource gaps and aligns with updated protocols

$r \approx 0.29$, $p < 0.001$

Agencies that recognize collaboration as a solution to resource and expertise shortages are more proactive in maintaining updated security protocols.

All relationships tested were statistically significant ($p < 0.05$)

This means the findings are unlikely due to chance, reinforcing that collaboration is indeed linked to improved data security performance.

Interpretation:

The results clearly indicate a positive and meaningful relationship between collaborative practices and the effectiveness of data security protocols. In particular:

Knowledge and resource sharing among agencies is a key driver of better security outcomes, especially in keeping protocols current.

Leveraging best practices from other agencies improves the overall confidence in data protection measures.

Agencies that view collaboration as a way to overcome internal constraints (e.g., budget, staffing) are more capable of maintaining robust cybersecurity standards.

Notably, the strength of the relationships ranges from weak to moderate, suggesting that while collaboration plays a significant role, other factors (e.g., funding, infrastructure, internal policies) may also be important.

Conclusion:

This analysis supports the idea that improving collaboration between social service agencies—especially through resource sharing and adopting best practices—can meaningfully enhance data security. Agencies aiming to strengthen their cybersecurity posture should invest in formal collaboration mechanisms, such as inter-agency training, shared technology platforms, and coordinated policy development.

Summary of Tests of This Section:

The analysis reveals that inter-agency collaboration positively influences data security effectiveness, with a moderate impact observed across various measures. The intercept value of 4.25 indicates that agencies without collaboration already have a baseline level of data security effectiveness. The coefficient for collaboration (0.56) shows that every unit increase in collaboration corresponds to a moderate improvement in security effectiveness, with collaboration explaining 57% of the variation in data security performance. Notably, sharing cybersecurity resources, leveraging best practices, and addressing expertise gaps contribute significantly to stronger data security protocols. However, other factors like funding, technology, and staff training also play crucial roles, as indicated by the remaining 43% variation.

Additionally, the Pearson correlation analysis highlights several positive relationships between collaboration and improved security protocols. Sharing cybersecurity resources is the strongest factor, correlating strongly with updating security protocols (r = 0.46), while collaboration also enhances protection and response to threats. Agencies that recognize collaboration as a solution to resource gaps tend to maintain updated protocols. All observed relationships were statistically significant, further supporting the link between collaboration and enhanced data security. Thus, agencies should focus on fostering collaboration through resource sharing and best practices while also addressing other factors to achieve comprehensive cybersecurity improvements.

4.7 Cyber-security Training, Compliance, and Funding Impact

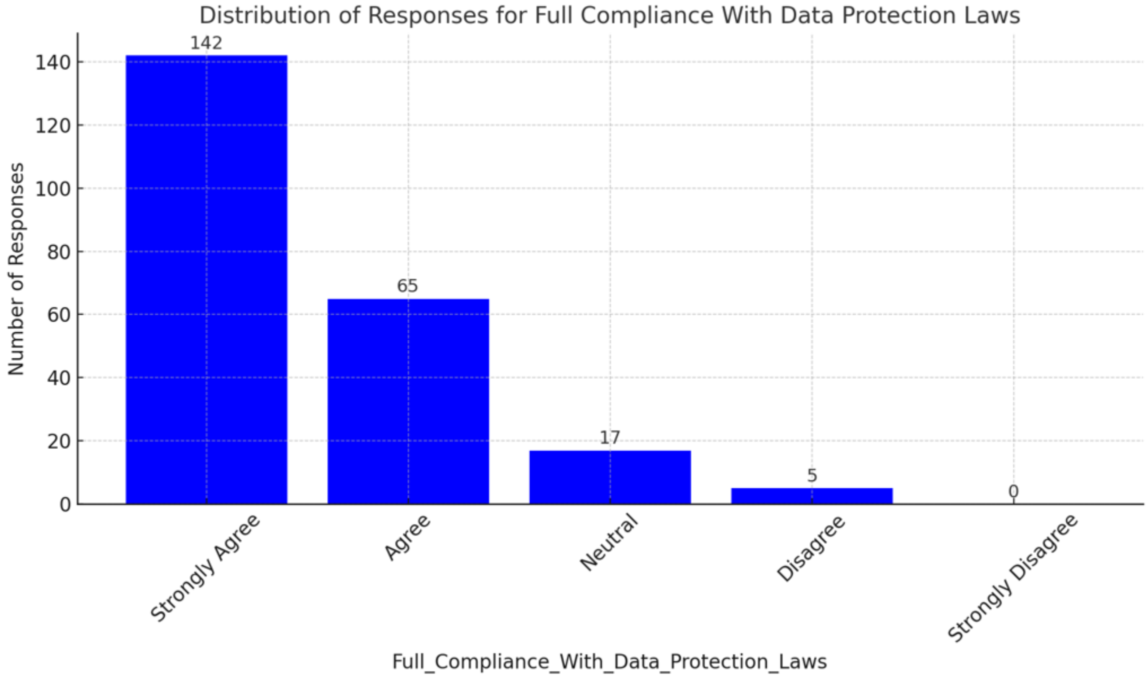

Figure 31 Distribution of Full Compliance with Data Protection Laws

Observation:

Positive Responses:

The majority of respondents Strongly Agree (142 responses) or Agree (65 responses) that their organisation is in full compliance with data protection laws. This indicates a high level of confidence in legal compliance.

Neutral Responses:

A smaller group (17 responses) provided a Neutral response, indicating some uncertainty or lack of strong opinion about their compliance status.

Negative Responses:

Very few respondents Disagree (5 responses), and none strongly disagree, showing minimal dissatisfaction or non-compliance with data protection laws.

Interpretation:

The responses suggest a generally high level of confidence in legal adherence among the agencies surveyed. The majority of respondents (142 responses) strongly agreed, and 65 respondents agreed, that their organisation fully complies with data protection laws. This indicates that most agencies believe they are effectively meeting the legal requirements. A smaller portion of respondents (17 responses) expressed neutrality, suggesting that while they may not have a strong opinion on the matter, there may be some uncertainty or lack of clarity about their full compliance status. This could indicate areas where further clarification or documentation regarding compliance is needed within these organisations. Only a small minority (5 responses) disagreed, with none strongly disagreeing, highlighting that the vast majority of respondents do not perceive any significant issues with non-compliance. This implies that data protection laws, particularly the PDPA, are largely understood and implemented correctly within these agencies, with only minimal concern regarding non-compliance.

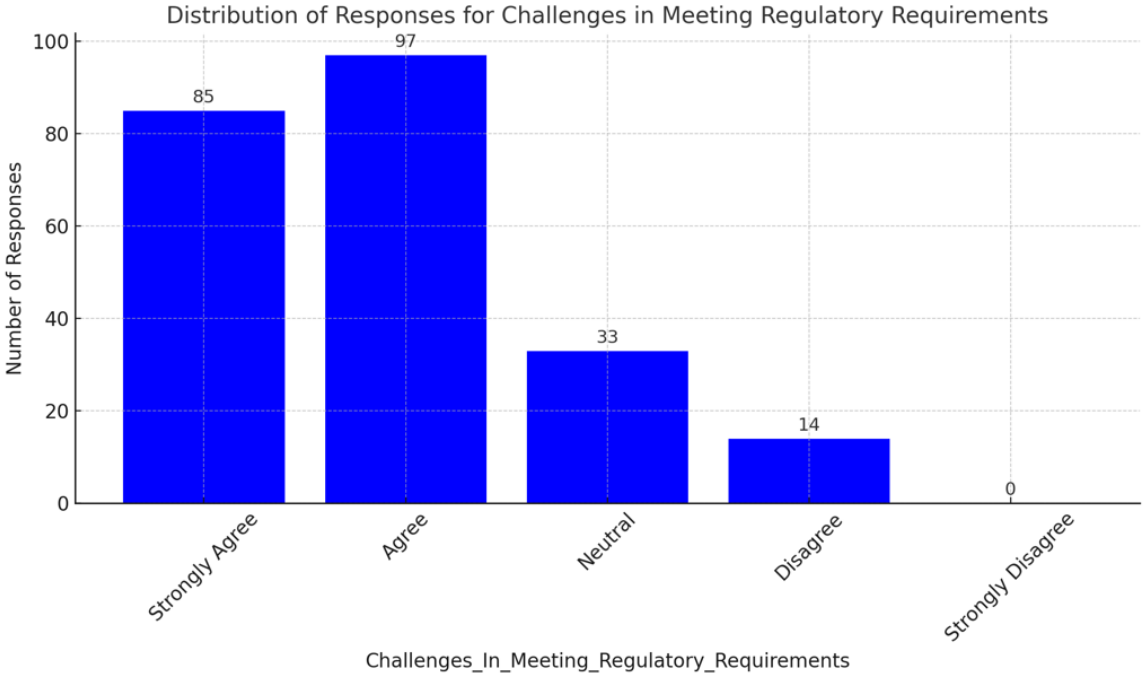

Figure 32 Distribution of Challenges in Meeting Regulatory Requirements

Positive Responses:

A significant majority of respondents Agree (97 responses) or Strongly Agree (85 responses) that they face challenges in meeting regulatory requirements. This indicates that a large portion of organisations perceive compliance as a difficult task.

Neutral Responses:

A smaller group (33 responses) provided a Neutral response, indicating some uncertainty or lack of a strong stance on whether meeting regulatory requirements is challenging.

Negative Responses:

A few respondents Disagree (14 responses), and none strongly disagree, showing minimal opposition to the perception of challenges in regulatory compliance.

Interpretation:

The results indicate that a substantial majority of respondents face difficulties in meeting regulatory data security requirements. Specifically, 97 respondents (a significant portion) agreed, and 85 respondents (a slightly smaller portion) strongly agreed that complying with regulatory data security standards is challenging. This suggests that most organisations involved in the study perceive regulatory compliance as a considerable obstacle.

In contrast, a smaller group of 33 respondents chose a neutral stance, which may reflect uncertainty or a lack of strong opinion on the matter. However, the number of respondents who disagreed (14 respondents) was relatively low, with no respondents strongly disagreeing with the statement. This minimal opposition further emphasizes that the perception of regulatory compliance as a challenge is largely shared among the respondents.

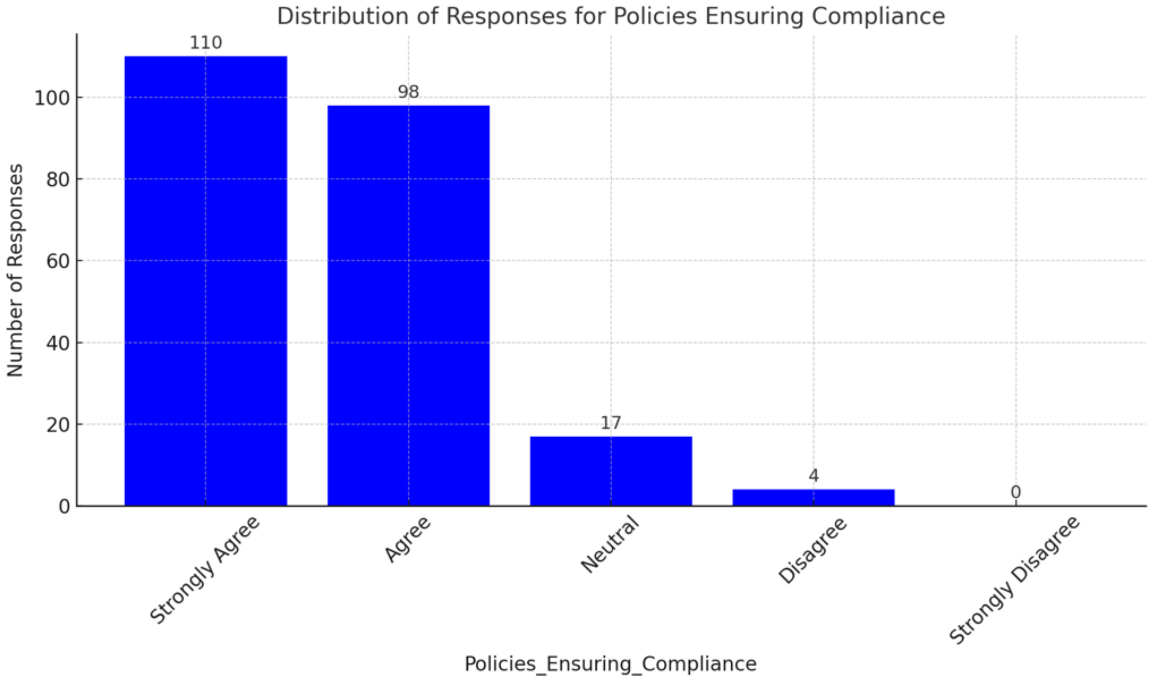

Figure 33 Distribution of Policies Ensuring Compliance

Positive Responses:

A large majority of respondents either Strongly Agree (110 responses) or Agree (98 responses) that their organisation has policies in place to ensure compliance. This indicates widespread confidence in organisational policies supporting compliance efforts.

Neutral Responses:

A smaller group (17 responses) provided a Neutral response, suggesting some uncertainty or lack of strong opinion about the adequacy of their compliance policies.

Negative Responses:

Very few respondents Disagree (4 responses), and none strongly disagree, indicating minimal dissatisfaction or lack of policies ensuring compliance.

Interpretation:

The data reveals a positive outlook on the presence of such policies. A significant majority of respondents, comprising 110 individuals who Strongly Agree and 98 who Agree, indicated that their organisation has policies in place to ensure compliance with security regulations. This suggests a high level of confidence in the organisational efforts to meet security standards and regulatory requirements, which aligns with the overall focus on data security highlighted in the research proposal. A smaller proportion of respondents, 17 individuals, selected a Neutral response, which implies a degree of uncertainty or a lack of a strong opinion on whether the existing policies are sufficient or fully effective. This might point to a need for further clarification or improvement in the communication or execution of these compliance policies. The Disagree responses were minimal, with only 4 individuals indicating dissatisfaction, and no respondents Strongly Disagreeing with the statement. This minimal negative feedback suggests that the vast majority of organisations are confident that they have policies in place, and there is little indication of widespread issues or dissatisfaction regarding compliance with security regulations.

Overall, these findings reflect a positive perception of data security policies and regulatory compliance efforts within the organisations surveyed, aligning with the research's goal of assessing current data security practices in Singapore's funded social service agencies.

However, the neutral responses could indicate areas for improvement, particularly in policy clarity and implementation.

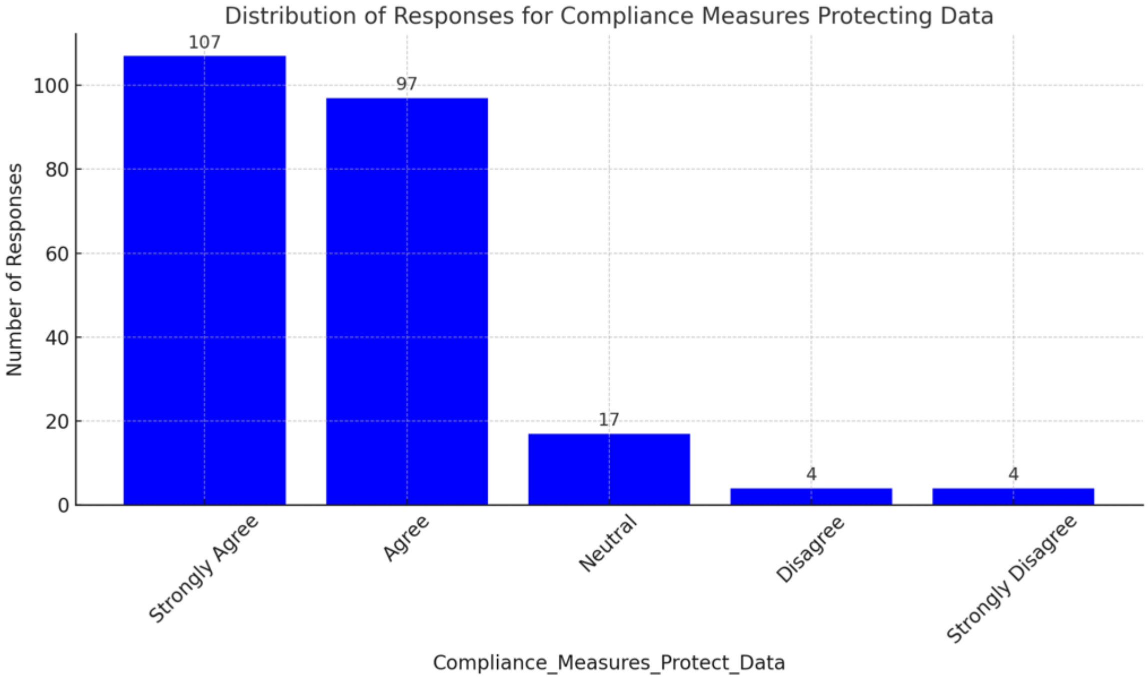

Figure 34 Distribution of Compliance Measures Protect Data

Positive Responses:

The majority of respondents Strongly Agree (107 responses) or Agree (97 responses) that compliance measures effectively protect data. This indicates widespread confidence in the effectiveness of compliance measures.

Neutral Responses:

A smaller group (17 responses) provided a Neutral response, showing some uncertainty or lack of a strong opinion about the role of compliance measures in protecting data.

Negative Responses:

Very few respondents Disagree (4 responses) or Strongly Disagree (4 responses), reflecting minimal dissatisfaction or skepticism regarding the effectiveness of compliance measures.

Interpretation:

The data suggest a generally positive perception among respondents regarding the effectiveness of compliance measures in safeguarding sensitive information.

The majority of respondents, specifically 107 individuals (Strongly Agree) and 97 individuals (Agree), expressed confidence in the ability of these measures to protect data. This indicates a widespread belief that the current compliance protocols are effective in securing sensitive information, aligning with the expectations set by regulatory frameworks like Singapore's Personal Data Protection Act (PDPA), which are a key focus of the study. A smaller group, consisting of 17 respondents, selected a Neutral response, suggesting that while they do not express a strong opinion, they may either have insufficient knowledge about the specific measures or do not fully trust their effectiveness. This could be an area of concern for further exploration, especially in terms of communication and training regarding compliance protocols. The minimal number of respondents who disagreed (4 responses) or strongly disagreed (4 responses) indicates that there is little dissatisfaction or skepticism surrounding the efficacy of compliance measures. This further emphasizes the overall positive reception of the measures in place, although it also highlights a very small number of individuals who may feel that improvements are still necessary.

In conclusion, the responses indicate strong confidence in the effectiveness of the compliance measures currently in place to protect sensitive data. However, there is room for further engagement with the small subset of respondents who remain neutral or negative, ensuring that all stakeholders are fully informed and confident in these protective measures. This ties in with the study's goal to evaluate and strengthen data security protocols in funded social service agencies.

Overall Summary of Bar graphs of Section 5:

The bar graphs in Section 6 highlight organisations' strong focus on compliance with data protection laws, while also shedding light on significant challenges. Most respondents express high confidence in their full compliance with data protection regulations, reflecting a commitment to meeting legal standards. There is also widespread agreement that policies ensuring compliance and compliance measures effectively protect data, showcasing well-structured approaches to safeguarding sensitive information. However, a large portion of respondents acknowledges the challenges in meeting regulatory requirements, underlining the complexity and resource demands of staying compliant. While the overall sentiment is positive, the recognition of these hurdles emphasizes the need for simplified processes, enhanced guidance, and adequate resources to ensure consistent compliance across all organisations. This balance of confidence and challenges underscores the importance of strategic efforts to strengthen compliance frameworks while addressing the barriers faced by many organisations.

Objective 5 Test Regression Analysis

```
==============================================================================

Dep. Variable:     data_security_challenge   R-squared:           0.286
Model:                        OLS   Adj. R-squared:               0.282
Method:               Least Squares   F-statistic:                90.76
Date:              Wed, 09 Jul 2025   Prob (F-statistic):        2.58e-18
Time:                     10:51:17   Log-Likelihood:            -253.31
No. Observations:              229   AIC:                       510.6
Df Residuals:                  227   BIC:                       517.5
Df Model:                        1
Covariance Type:         nonrobust
==============================================================================
                   coef    std err        t      P>|t|     [0.025      0.975]
------------------------------------------------------------------------------
const             1.2191      0.307      3.974      0.000      0.615      1.824
compliance_measures    0.6569      0.069      9.527      0.000      0.521      0.793
==============================================================================
Omnibus:                   85.994   Durbin-Watson:                 1.847
Prob(Omnibus):              0.000   Jarque-Bera (JB):            205.042
Skew:                      -1.780   Prob(JB):                  2.99e-45
Kurtosis:                   5.969   Cond. No.                      29.5
```

Observations and Interpretation:

1. R-squared: 0.286

Observation: The R-squared value of 0.286 indicates that 28.6% of the variability in data security challenges can be explained by compliance measures.

Interpretation: While compliance measures are significant, the remaining 71.4% of the variation in data security challenges is influenced by other factors not included in the model, such as budget constraints, staffing issues, or organisational structures.

2. F-statistic: 90.76

Observation: The F-statistic is 90.76, and the p-value for the F-test is 2.58e-18.

Interpretation: This indicates that the overall regression model is statistically significant. The independent variable (compliance measures) is a meaningful predictor of the dependent variable (data security challenges). The very low p-value further confirms that the model is not due to random chance.

Coefficients:

1. Intercept (const): 1.2191

Observation: The intercept value is 1.2191, meaning that when the compliance measures score is zero, the predicted data security challenge score is 1.2191.

Interpretation: This represents the baseline level of challenges in data security when there are no compliance measures in place. This suggests that even without specific measures in place, agencies face some level of challenges in implementing data security.

2. Compliance Measures (compliance_measures): 0.6569

Observation: The coefficient for compliance measures is 0.6569, with a p-value of 0.000.

Interpretation: For each unit increase in compliance measures, the data security challenge score is expected to increase by 0.6569 units. This indicates that more stringent compliance measures (such as fully adhering to data protection laws or having policies in place) are associated with greater challenges in implementing data security. These challenges could arise from the complexity of maintaining compliance, regulatory requirements, or the resources needed to meet these standards.

Standard Errors and t-statistics:

1. Standard Error for Compliance Measures: 0.069

Observation: The standard error for the compliance measures coefficient is 0.069.

Interpretation: This value indicates the precision of the coefficient. A smaller standard error suggests that the estimate of the coefficient is relatively precise.

2. t-statistic for Compliance Measures: 9.527

Observation: The t-statistic for compliance measures is 9.527, which is significantly higher than typical critical values (e.g., 1.96 for a 95% confidence level).

Interpretation: This indicates that the compliance measures variable is highly statistically significant in predicting data security challenges. The t-statistic further reinforces the strength of the relationship.

Confidence Interval for Compliance Measures:

95% Confidence Interval: [0.521, 0.793]

Observation: The confidence interval for the compliance measures coefficient is [0.521, 0.793].

Interpretation: We are 95% confident that the true effect of compliance measures on data security challenges lies between 0.521 and 0.793. This interval does not include zero, further confirming the statistical significance of the result.

Conclusion:

Compliance measures significantly affect the challenges faced by social service agencies in implementing data security. The stronger the compliance measures, the greater the challenges in meeting data security requirements.

The model has an R-squared of 0.286, suggesting that compliance measures explain around 28.6% of the variability in the challenges agencies face. While compliance is important, other factors (like budget, staffing, or tools) also contribute to the challenges.

The F-statistic confirms that the regression model is statistically significant, indicating a meaningful relationship between compliance measures and data security challenges.

The coefficient for compliance measures is positive (0.6569), indicating that stronger compliance results in more significant challenges in implementing data security, possibly due to the complexity of regulatory requirements.

Objective 5 Test Spearman Correlation

Result

(0.6248455785104078, 3.347950352369687e-26)

Observation Interpretation:

Spearman's Correlation Coefficient: 0.625

Observation: There is a moderate positive correlation between compliance measures (e.g., fully complying with data protection laws, having security policies) and data security challenges (the difficulty in meeting regulatory data security requirements).

Interpretation: As the compliance measures within an agency increase, the challenges faced in implementing data security also tend to increase. This suggests that agencies with stronger compliance measures are likely encountering greater difficulties in meeting data security requirements. These challenges could arise from the complexity of adhering to strict regulations, resource demands, or the need to continuously update protocols to remain compliant.

p-value: 3.35e-26

Observation: The p-value is very small (3.35e-26), which indicates that the relationship between compliance measures and data security challenges is statistically significant.

Interpretation: Since the p-value is well below the standard significance level of 0.05, we can confidently conclude that the observed positive relationship is not due to chance. This reinforces the idea that agencies with higher compliance measures are consistently facing greater challenges in implementing effective data security.

Conclusion:

Strong Relationship: The analysis reveals a moderate positive relationship between compliance measures and data security challenges. As agencies enhance their compliance measures, they face more challenges in meeting regulatory data security requirements.

Implications: While strong compliance measures are essential for protecting sensitive data, they may introduce complexity and increase the operational burden on agencies, highlighting the need for balancing compliance with practical, efficient security strategies.

Summary of Tests of this section:

The regression analysis reveals that compliance measures have a significant impact on data security challenges faced by social service agencies. The model, with an R-squared value of 0.286, indicates that compliance measures explain 28.6% of the variability in data security challenges. The coefficient for compliance measures is 0.6569, suggesting that stronger compliance measures correlate with more significant challenges in implementing data security. This could be due to the complexity and resource demands of maintaining compliance with regulatory requirements. The F-statistic of 90.76 confirms the model's statistical significance, further supporting the relationship between compliance measures and security challenges.

Spearman's correlation analysis also shows a moderate positive correlation (0.625) between compliance measures and data security challenges, with a p-value of 3.35e-26 confirming the statistical significance of this relationship. This suggests that as agencies increase their compliance efforts, they encounter greater difficulties in meeting data security requirements. This correlation underlines the operational burden compliance imposes, highlighting the need for a balanced approach to regulatory adherence and practical data security strategies.

4.8 Conclusion:

Based on the data collected and analyzed in this research, it is evident that while many social service agencies in Singapore have made considerable strides in improving their data security protocols, significant challenges remain. The study found that larger agencies, those with sufficient funding, and those equipped with the necessary tools and trained staff tend to have stronger data security measures. Conversely, agencies facing budget constraints, staffing issues, and limited resources struggle to implement and maintain effective security protocols. Additionally, the research highlights that compliance with data protection laws and the ability to respond swiftly to security incidents are closely tied to funding and organisational capacity.

While most agencies reported having comprehensive data breach plans and preventive measures, difficulties in recruiting skilled cybersecurity staff and integrating new security protocols were prevalent. This research underscores the critical need for targeted investments in training, improved staffing, and increased funding to enhance data security across the sector, particularly for smaller and less-funded agencies.

In conclusion, the findings suggest that the effectiveness of data security protocols in funded social service agencies is strongly influenced by available resources, with financial and expertise limitations being the primary barriers. As the sector continues to evolve digitally, these agencies must prioritize strengthening their cybersecurity infrastructures through better resource allocation, continuous training, and collaboration to safeguard sensitive data effectively. Addressing these challenges will be key to ensuring that social service agencies in Singapore can maintain their critical role in supporting vulnerable populations while protecting the data entrusted to them.

CHAPTER V:
DISCUSSION

5.1 Discussion of Data Security Protocols in Funded Social Service Agencies

The findings from Objective 1 provide valuable insights into the current state of data security protocols in funded social service agencies in Singapore. A majority of respondents expressed confidence in the effectiveness of their data security protocols, with 125 agreeing and 89 strongly agreeing that the protocols are effective and regularly updated. This is consistent with the regulatory environment in Singapore, particularly the Personal Data Protection Act (PDPA), which mandates strong data security practices. However, a small portion of respondents expressed either neutrality or dissatisfaction with the protocols, indicating that, while the majority view the protocols as effective, there may be areas for improvement or better communication, particularly among those who are uncertain or dissatisfied with the current state of data security.

Regarding the ability of these protocols to address new cybersecurity threats, most respondents (118 agreeing and 80 strongly agreeing) were confident in their adaptability. This indicates that social service agencies are aware of the need to continuously evolve their data security measures in response to emerging threats, such as phishing and ransomware. However, the 22 neutral responses suggest that some agencies may lack familiarity with the specifics of their protocols' effectiveness in tackling new threats. The relatively small number of negative responses (9 disagreeing) further supports the notion that most agencies are prepared to counter emerging risks, but some uncertainty remains within the sector.

A significant number of respondents (89 agreeing and 43 strongly agreeing) acknowledged the difficulty in implementing new data security protocols, highlighting the challenges faced by social service agencies in adopting new measures. This is likely due to various factors such as compatibility issues with existing systems, limited technical expertise, and resource constraints. The 60 neutral responses indicate that some agencies may not perceive the difficulty as intensely, which could reflect varying levels of preparedness or the nature of the protocols being implemented. While some agencies face significant hurdles, others appear more capable of integrating new security measures into their existing systems.

The majority of respondents (99 agreeing and 92 strongly agreeing) indicated that their data security protocols are regularly updated. This suggests that most agencies prioritize keeping their security measures current, aligning with best practices in cybersecurity. However, the 19 neutral responses and 19 negative responses (15 disagreeing and 4 strongly disagreeing) indicate potential gaps in the consistency or frequency of protocol updates. This suggests that some agencies may struggle with maintaining regular updates due to limited resources, inadequate training, or a lack of awareness of evolving security standards.

A majority of respondents (82 agreeing and 70 strongly agreeing) felt that their agency's budget was sufficient for cybersecurity needs, reflecting confidence in the financial resources allocated for data security. However, the 56 neutral responses and 21 negative responses suggest that some agencies are unsure or dissatisfied with their cybersecurity budgets. This points to the ongoing challenge of securing adequate funding for robust data protection measures. The findings highlight the importance of increasing investment in cybersecurity infrastructure to ensure that all agencies are equipped to address emerging threats effectively.

Most respondents (108 agreeing and 63 strongly agreeing) reported that their agency has the necessary tools and technology for data security, which aligns with the research's emphasis on the importance of technological infrastructure in safeguarding sensitive information. However, 33 neutral responses and 25 negative responses indicate that some agencies may be lacking in the necessary tools or may be using outdated technology. This suggests that while most agencies are equipped with the basic tools for data security, there remains room for improvement in ensuring all agencies have access to the latest technologies.

A significant majority of respondents (101 agreeing and 55 strongly agreeing) recognized that funding and expertise limitations impact their ability to implement robust data security measures. This supports the research's argument that financial constraints and the difficulty in hiring skilled cybersecurity staff are major challenges for many social service agencies. While these challenges are widely acknowledged, it is essential that agencies receive more targeted support to overcome these barriers, especially as the demand for skilled professionals in the cybersecurity field grows.

Finally, a notable proportion of respondents (70 strongly agreeing and 54 agreeing) reported difficulty in hiring skilled cybersecurity staff, primarily due to budget constraints. This aligns with broader trends in the cybersecurity job market, where specialized skills are in high demand. The results underscore the importance of investing in training and professional development to address staffing shortages and ensure that social service agencies are equipped to manage cybersecurity risks effectively.

5.2 Discussion of Data Security Assessment

The results from Objective 2 provide insightful analysis regarding the preparedness and effectiveness of data security measures in funded social service agencies, particularly focusing on incident response strategies and preventive measures. A majority of respondents expressed strong confidence in their organisations' preparedness for data breaches, with 116 agreeing and 81 strongly agreeing that they have a comprehensive data breach plan. This suggests that many agencies recognize the importance of having a structured approach to managing security incidents, which is consistent with the requirements of regulatory frameworks like the Personal Data Protection Act (PDPA). However, a small proportion of respondents (17 neutral, 7 disagreeing, and 8 strongly disagreeing) indicated some uncertainty or dissatisfaction, highlighting areas where awareness or communication about data breach preparedness could be improved.

Regarding the speed of incident response, the results show that most agencies (114 agreeing and 101 strongly agreeing) believe they have quick response mechanisms in place. This high level of confidence suggests that most organisations are able to act promptly when security incidents occur, reducing the potential impact on sensitive data. However, a small group of respondents (9 neutral, 1 disagreeing, and 4 strongly disagreeing) indicates that not all agencies feel equally confident in their ability to respond quickly, which could point to inconsistencies in response times or varying levels of preparedness among agencies.

In terms of preventive measures, the responses were overwhelmingly positive, with 110 strongly agreeing and 98 agreeing that their agencies have effective preventive strategies in place to minimize data breaches. This suggests that many social service agencies are actively working to prevent breaches through well-established protocols. A small number of respondents (7 neutral, 10 disagreeing, and 4 strongly disagreeing) expressed uncertainty or dissatisfaction, indicating that some agencies may face challenges in implementing sufficient preventive measures or have concerns about their effectiveness.

The findings also indicate that most agencies (104 agreeing and 96 strongly agreeing) regularly improve their incident response strategies. This reflects a proactive approach to cybersecurity, with organisations continuously refining their response plans to address new threats and challenges. However, the 21 neutral responses suggest that there may be some variability in how regularly incident response improvements are implemented across different agencies, with some organisations perhaps needing clearer communication or more consistent practices.

The ANOVA results revealed significant differences in the effectiveness of incident response strategies based on factors such as agency type and funding source. For example, agencies with stable funding, particularly government-funded ones, were more likely to have comprehensive data breach plans, respond quickly to security incidents, and implement effective preventive measures. These findings underscore the importance of adequate financial resources in enabling agencies to develop and maintain robust cybersecurity infrastructures. Additionally, training effectiveness was found to have a highly significant correlation with improved incident response and preventive measures. This highlights the critical role that staff training plays in reducing human error and enhancing the overall cybersecurity posture of organisations.

Furthermore, Pearson's correlation analysis indicated strong relationships between training, adequate budgets, and the availability of necessary tools and technology with the effectiveness of incident response strategies. Agencies that invest in comprehensive training programs and have sufficient financial resources are better equipped to prevent breaches and respond swiftly when incidents occur. Conversely, agencies facing staffing shortages and budget constraints tend to struggle with effective incident response, reinforcing the need for improved resource allocation.

5.3 Cyber-security Practices

The results from Objective 3 highlight the critical role that regular staff training and a strong cybersecurity awareness culture play in improving data security protocols within social service agencies. A large majority of respondents (97 agreeing and 89 strongly agreeing) indicated that their organisations provide regular training on cybersecurity. This suggests that most agencies recognize the importance of cybersecurity education and are actively investing in enhancing their staff's capabilities. However, a small group of respondents (28 neutral, 5 disagreeing, and 10 strongly disagreeing) pointed to some uncertainties or gaps in the regularity or effectiveness of the training. This highlights potential areas for improvement, particularly in ensuring consistency and addressing any inconsistencies across different agencies or departments.

Further analysis revealed that a significant majority (104 agreeing and 99 strongly agreeing) of respondents believe that training reduces breaches caused by human error. This underscores the importance of training in minimizing one of the most common vulnerabilities in cybersecurity. The results suggest that by improving staff awareness and reducing human errors, agencies can significantly enhance their data security measures. Although a small group (18 neutral, 4 disagreeing, and 4 strongly disagreeing) expressed some uncertainty, the overwhelming majority supports the positive impact of training on reducing breaches. This consensus reinforces the findings from the research proposal, which emphasizes the importance of effective training to mitigate human errors.

The analysis also showed strong support for frequent training programs, with 95 respondents strongly agreeing and 94 agreeing that regular training is essential for keeping staff informed about emerging threats. This aligns with the research proposal's recommendation for ongoing staff development to maintain high levels of cybersecurity awareness. However, a small group of 29 respondents expressed neutral opinions, which could indicate a need for better communication or understanding of the training's importance. This could point to areas where additional effort is required to ensure that all staff members receive adequate and consistent training.

Another key finding was that a large majority of respondents (119 strongly agreeing and 73 agreeing) believed their organisations have fostered a strong cybersecurity awareness culture. This is an encouraging sign that many social service agencies are successfully integrating cybersecurity as a core value within their organisational culture. However, a small portion (16 neutral, 17 disagreeing, and 4 strongly disagreeing) expressed uncertainty or disagreement, highlighting potential gaps in fostering this culture across all departments. These responses indicate that while the majority of agencies have made progress, there is still room for improvement in instilling a pervasive culture of cybersecurity awareness throughout all levels of the organisation.

Regression analysis revealed that the effectiveness of data security protocols is strongly associated with the extent of staff training, particularly training that reduces human error. The model indicated that for every unit increase in training effectiveness, there was a notable improvement in the effectiveness of data security protocols. The coefficient for training effectiveness was highly significant (p-value = 0.000), reinforcing the role of training in enhancing overall data security. Additionally, fostering a strong cybersecurity awareness culture was found to be a significant predictor of improved data security protocols, with a positive relationship between a strong culture and better cybersecurity outcomes. However, the frequency of training, while positive, was not statistically significant in improving data security protocols, suggesting that training effectiveness is more important than simply the frequency of training sessions.

T-test results further reinforced the importance of employee training and cybersecurity awareness. Agencies with higher training levels reported significantly more effective data security protocols, better capacity to address new cybersecurity threats, more frequent updates to protocols, and stronger incident response plans. These findings provide robust evidence that well-trained staff are more capable of responding to incidents, reducing human errors, and maintaining up-to-date security measures. The statistically significant p-values (e.g., p = 0.00002 for protocol effectiveness and p = 0.000006 for regular protocol updates) highlight the strong relationship between training and improved data security practices.

5.4 Data Security Enhancement

The results from Objective 4 underscore the importance of inter-agency collaboration and the sharing of resources in enhancing data security effectiveness within funded social service agencies. The data revealed mixed responses regarding the sharing of cybersecurity resources. A significant portion of respondents (95) were neutral on the idea, reflecting uncertainty or a lack of strong opinion about resource sharing. However, there was a moderate level of support, with 67 agreeing and 31 strongly agreeing that sharing resources could be beneficial. Despite this, some respondents (31 disagreeing and 5 strongly disagreeing) expressed opposition to the practice, suggesting concerns about confidentiality, resource constraints, or potential security risks associated with collaboration. This variability points to the need for further investigation into the underlying barriers that prevent agencies from engaging in resource-sharing practices, which could include regulatory, technical, or logistical challenges.

In contrast, a more positive trend emerged when agencies were asked about using best practices from other organisations. A significant majority of respondents (104 agreeing and 48 strongly agreeing) indicated that they adopt best practices from other agencies, demonstrating a broad acceptance of peer learning and collaboration. Although a portion (68) remained neutral, suggesting some ambivalence or uncertainty, the small number of respondents who disagreed (5) or strongly disagreed (4) further highlights the openness within the sector to learning from others. This aligns with the research proposal’s emphasis on the value of collaboration and knowledge sharing as effective strategies to bolster data security in social service agencies.

Collaboration as a tool to overcome resource and expertise gaps received strong support, with 129 agreeing and 44 strongly agreeing that it helps address these challenges. This widespread recognition underscores the importance of working together to mitigate financial and technical constraints. However, the 49 neutral responses indicate that some agencies may be uncertain about how to implement such collaborations or may face unique barriers preventing them from fully capitalizing on collaborative opportunities. Despite these uncertainties, the overall sentiment suggests that collaboration is viewed as a valuable means to enhance cybersecurity and improve operational efficiency.

The results also highlighted a key challenge in collaboration: data sensitivity. A significant majority (117 agreeing and 50 strongly agreeing) believed that data sensitivity limits collaboration, reflecting concerns over privacy and security when sharing sensitive information. However, a smaller group (18 disagreeing and 6 strongly disagreeing) did not perceive data sensitivity as a significant barrier, indicating that some agencies have implemented protocols to address these concerns, enabling them to collaborate more effectively. This finding suggests a need for strategies that balance data protection with collaboration, ensuring that sensitive information remains secure while fostering partnerships that strengthen overall data security practices.

Regression analysis revealed that inter-agency collaboration has a moderate but significant impact on the effectiveness of data security practices. The coefficient of 0.56 indicates that for every unit increase in collaboration, the data security effectiveness score is expected to increase by 0.56. This relationship demonstrates that collaboration—particularly in the form of resource sharing, best practice adoption, and addressing expertise gaps—has a meaningful impact on improving data security protocols and incident response strategies. The R-squared value of 0.57 suggests that collaboration explains a substantial portion of the variation in data security effectiveness, though other factors such as funding, training, and tools also contribute to the overall security posture of agencies.

The Pearson correlation analysis further supports these findings, revealing strong positive relationships between collaboration and enhanced data security. For example, sharing cybersecurity resources was strongly correlated with regularly updating security protocols (r

= 0.46), while adopting best practices from other agencies was positively correlated with perceived protection of sensitive information (r = 0.35). Additionally, agencies that recognized collaboration as a way to overcome resource gaps were more proactive in maintaining updated security protocols (r = 0.29). These findings highlight that collaboration not only strengthens current data security measures but also plays a critical role in ensuring continuous improvement.

5.5 Cyber-security Training, Compliance, and Funding Impact

The results from Objective 5 explore the relationship between compliance with data protection laws, the challenges faced by social service agencies in meeting regulatory requirements, and the impact of funding and cybersecurity training on these challenges. The data shows a strong sense of confidence among agencies in their compliance with data protection laws, with a majority of respondents (142 strongly agreeing and 65 agreeing) affirming that their organisations are fully compliant. A small minority (5 disagreed, 0 strongly disagreed) expressed dissatisfaction, indicating that overall, these agencies view compliance with regulations, such as the PDPA, as an achievable and important goal. However, there was a group of 17 respondents who expressed neutrality, suggesting some uncertainty regarding their organisation's exact compliance status, which may point to areas where further clarification or verification of compliance is necessary.

Despite the high level of compliance confidence, a significant portion of respondents (97 agreed and 85 strongly agreed) acknowledged challenges in meeting regulatory requirements. This highlights the complexity and resource intensity involved in ensuring full compliance. The difficulty is further emphasized by the relatively few respondents (14) who disagreed with the statement, suggesting that the challenge of meeting regulatory requirements is a widespread concern. This finding aligns with the broader understanding that while compliance is critical, it imposes significant operational burdens, and many agencies struggle to maintain alignment with evolving data protection laws and regulations.

Policies ensuring compliance were largely reported as being in place, with 110 respondents strongly agreeing and 98 agreeing that their organisations have policies that help them adhere to data security regulations. Only a small number of respondents (17 neutral, 4 disagreed, and none strongly disagreed) expressed uncertainty or dissatisfaction with their organisation's compliance policies, further reinforcing the view that compliance policies are commonly implemented and seen as effective in most agencies. However, the neutral responses suggest a possible gap in understanding or confidence in the policies' full effectiveness, which could benefit from additional internal communication or staff training.

When asked about the effectiveness of compliance measures in protecting data, the majority of respondents (107 strongly agreed and 97 agreed) expressed confidence in their organisation's ability to safeguard sensitive information through these measures. However, 17 respondents were neutral, and a small portion (4 disagreed and 4 strongly disagreed), suggesting that there might be concerns or a lack of awareness about the full effectiveness of these measures in certain agencies. This mixed feedback points to the need for continual improvements and communications regarding the effectiveness of compliance measures to ensure that all staff members are aligned in their understanding of data protection.

The regression analysis for Objective 5 reveals that compliance measures are significantly associated with increased challenges in data security implementation, with a coefficient of 0.6569. This positive relationship suggests that as agencies adopt stronger compliance measures, they face more significant operational and technical challenges in maintaining data security, likely due to the complexity of regulations and the resource demands required to stay compliant. The R-squared value of 0.286 indicates that compliance measures explain 28.6% of the variation in the challenges agencies face, meaning that other factors—such as staffing issues, budget constraints, and organisational structures—also contribute significantly to the challenges.

Additionally, Spearman's correlation analysis shows a moderate positive correlation (0.625) between the strength of compliance measures and the challenges agencies face in implementing data security. The very low p-value (3.35e-26) confirms the statistical significance of this relationship, reinforcing the idea that while compliance is necessary for protecting data, it also imposes significant operational burdens on agencies. This result underlines the need for agencies to balance compliance with practical, efficient security strategies to mitigate these challenges.

5.6 Discussion of Research Questions

1. How do funded social service agencies in Singapore face the key challenges in implementing advanced data security measures?

The findings from this study reveal that funded social service agencies in Singapore encounter several key challenges in implementing advanced data security measures. A significant portion of respondents acknowledged difficulties in adopting new data security protocols, with 89 agreeing and 43 strongly agreeing that these measures are difficult to implement. The challenges are often due to compatibility issues with existing systems, limited technical expertise, and resource constraints. These challenges align with the financial and staffing limitations that many agencies face, as highlighted by the 101 respondents who agreed that funding and expertise limitations impact their ability to implement robust data security measures. Furthermore, the difficulty in hiring skilled cybersecurity staff due to budget constraints (70 strongly agreeing and 54 agreeing) underscores the ongoing struggles in securing the necessary human resources for effective data protection.

Additionally, while many respondents (82 agreeing and 70 strongly agreeing) felt their cybersecurity budgets were adequate, a notable number (56 neutral and 21 negative responses) highlighted that some agencies may still face financial constraints. These funding issues directly affect the ability to implement advanced data security measures, especially as the demand for cybersecurity expertise grows. The findings suggest that social service agencies need better access to financial resources and technical training to effectively address emerging cybersecurity threats.

2. How effective are the current incident response strategies in funded social service agencies in Singapore at mitigating data breaches?

The data shows that incident response strategies in funded social service agencies in Singapore are generally perceived as effective in mitigating data breaches, though there are areas for improvement. The majority of respondents (116 agreeing and 81 strongly agreeing) reported that their organisations have comprehensive data breach plans, suggesting a strong awareness of the importance of structured responses to data security incidents. Similarly, 114 respondents agreed and 101 strongly agreed that their organisations have quick incident response mechanisms in place. This reflects that the majority of agencies feel well-prepared to respond swiftly to incidents, thereby minimizing the impact of data breaches.

However, despite the positive feedback, a small proportion of respondents (17 neutral, 7 disagreeing, and 8 strongly disagreeing) expressed some uncertainty or dissatisfaction with their agencies' preparedness. This highlights that there is variability in how effective incident response strategies are across agencies, which may be influenced by factors such as staff training, available resources, and the clarity of response protocols. The ANOVA results suggest that agencies with stable funding and effective training programs were better equipped to respond to security incidents, emphasizing the need for consistent training and resource allocation to enhance the effectiveness of these strategies.

3. What role do employee training and awareness programs play in enhancing data security protocols in funded social service agencies in Singapore?

Employee training and awareness programs play a critical role in enhancing data security protocols within social service agencies. A significant majority of respondents (97 agreeing and 89 strongly agreeing) indicated that their organisations provide regular training on cybersecurity, reflecting the widespread recognition of the importance of staff education in improving data security. The results from the Pearson correlation analysis reinforce this, showing that training programs, particularly those aimed at reducing human error, are strongly associated with improved data security protocols. A substantial number of respondents (104 agreeing and 99 strongly agreeing) affirmed that training helps reduce breaches caused by human error, which is one of the most common vulnerabilities in cybersecurity.

Despite the broad support for training, some respondents (28 neutral, 5 disagreeing, and 10 strongly disagreeing) expressed uncertainty or dissatisfaction, suggesting that there may be variability in the effectiveness and consistency of training programs across agencies. Additionally, while frequent training programs were widely supported (95 strongly agreeing and 94 agreeing), the neutral responses (29) point to some uncertainty regarding the frequency and importance of training. The regression analysis further supports the importance of training, with a strong positive relationship found between the extent of training and the effectiveness of data security protocols. This suggests that continuous, targeted training programs are essential for reducing human error and strengthening overall security measures.

4. How can collaboration between funded social service agencies in Singapore be improved to strengthen data security?

Collaboration between funded social service agencies in Singapore is seen as an important avenue for improving data security, but there are barriers to fully realizing its potential. A moderate number of respondents (67 agreeing and 31 strongly agreeing) expressed support for sharing cybersecurity resources, while a larger group (95 neutral responses) remained uncertain about the practice. This neutral stance indicates that while some agencies see the value in collaboration, there are concerns related to confidentiality, resource allocation, and potential risks associated with sharing sensitive information.

The data also showed that agencies that adopt best practices from other organisations are more likely to report stronger security protocols, with 104 agreeing and 48 strongly agreeing on the usefulness of best practices from other agencies. However, there were also a significant number of neutral responses (68), reflecting ambivalence about fully embracing inter-agency collaboration. The strongest support came from respondents (129 agreeing and 44 strongly agreeing) who recognized that collaboration helps overcome resource and expertise gaps. This suggests that inter-agency collaboration can play a key role in addressing common challenges such as staffing shortages, limited budgets, and outdated technologies.

However, data sensitivity was identified as a major barrier to collaboration, with many respondents (117 agreeing and 50 strongly agreeing) noting that the sensitivity of data limits their ability to collaborate with other agencies. While some respondents (18 disagreeing and 6 strongly disagreeing) did not view data sensitivity as a significant barrier, the majority recognized the importance of balancing data security with the benefits of collaboration. This finding suggests that, to improve collaboration, agencies need to implement clear guidelines and secure mechanisms for sharing resources and best practices, ensuring that data privacy and security are not compromised.

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

This dissertation aimed to explore the current state of data security practices within funded social service agencies in Singapore, with a focus on the challenges these agencies face in implementing data security measures, the effectiveness of their incident response strategies, and the role of employee training and inter-agency collaboration in strengthening their cybersecurity posture.

The findings of this research provide valuable insights into the state of data security within these organisations. In terms of data security protocols, the majority of respondents expressed confidence in the effectiveness of their data protection measures. However, challenges related to resource constraints, limited technical expertise, and the difficulty of keeping up with evolving cybersecurity threats were significant factors influencing their ability to implement advanced data security measures. While most agencies reported having comprehensive plans in place for data breaches and quick incident response mechanisms, there were variations in preparedness, particularly among those facing budgetary or staffing limitations. These challenges highlight the need for targeted support, both in terms of funding and skilled personnel, to enhance the capacity of social service agencies to address emerging threats.

Employee training and awareness were identified as critical components in improving data security. The study revealed that while most agencies provide regular cybersecurity training, there are gaps in its consistency and effectiveness across different organisations. Training programs that specifically target human error were found to be especially impactful in reducing data breaches. Furthermore, a strong culture of cybersecurity awareness within organisations was strongly correlated with improved data security protocols, further emphasizing the importance of ongoing staff education.

Collaboration between social service agencies emerged as a potential avenue for improving data security practices. The study found that while there was strong support for sharing resources and best practices, barriers such as data sensitivity and concerns over confidentiality limited the extent to which agencies could engage in inter-agency collaboration. Despite these barriers, there was widespread recognition of the value of collaboration in overcoming resource and expertise gaps. Agencies that collaborated more effectively tended to report stronger data security practices, particularly in updating protocols and responding to cybersecurity threats.

This research also highlighted the significant role that funding plays in the effectiveness of data security measures. Agencies with stable funding, particularly government-backed ones, were found to be more likely to implement comprehensive data breach plans and respond swiftly to incidents. On the other hand, agencies facing financial constraints were more likely to struggle with resource allocation and the recruitment of skilled cybersecurity staff, which in turn affected their ability to maintain effective data security measures.

6.2 Implications

The findings of this dissertation present several important implications for improving data security within funded social service agencies in Singapore. First and foremost, there is a clear need for increased financial investment in data security. Social service agencies often face budget constraints that hinder their ability to implement advanced data protection measures, recruit skilled cybersecurity personnel, and invest in up-to-date security technologies. To address these challenges, it is essential for funding bodies, including the government and other stakeholders, to allocate sufficient resources. This will empower agencies to enhance their security infrastructures and meet the growing demands of cybersecurity. Additionally, agencies must prioritize investment in cybersecurity education and skills development to address staffing shortages in the cybersecurity field.

Another critical implication is the importance of robust employee training and awareness programs. Human error is a major cause of data breaches, and the research highlights that effective and frequent training can mitigate this vulnerability. Social service agencies should focus on improving the effectiveness of their training programs by incorporating real-world scenarios and practical learning. It is essential for agencies to continually assess and refine these programs, ensuring that they are engaging and directly aligned with the evolving cybersecurity landscape. Moreover, creating a pervasive culture of cybersecurity awareness within these agencies will help promote proactive behavior in managing data security risks at all levels of the organisation.

The dissertation also emphasizes the need for greater collaboration between social service agencies to enhance data security. Inter-agency collaboration can alleviate resource constraints and foster the sharing of best practices. However, concerns about data sensitivity and privacy often act as barriers to collaboration. To overcome these challenges, agencies should work on developing clear and secure frameworks for collaboration. This could include creating encrypted platforms for information sharing and ensuring that all collaborating agencies adhere to standardized data security protocols. Additionally, forming public-private partnerships and collaborating with external cybersecurity experts can bridge gaps in resources and expertise, further strengthening the cybersecurity posture of social service agencies.

The need for regular reviews and updates to data security protocols is another significant implication. The rapidly evolving nature of cybersecurity threats necessitates that agencies continually refine and update their security measures. Agencies must prioritize the regular review of their security protocols, ensuring that they remain relevant and effective against new risks, such as ransomware and phishing. Implementing clear timelines for the review and testing of these protocols will help ensure that organisations are always prepared to face emerging cybersecurity challenges. Proactively addressing these concerns will enable agencies to maintain a strong defense against evolving threats.

6.3 Recommendations for Future Research

The recommendations for enhancing data protection and cybersecurity, derived from the findings in this research, extend beyond the context of Singapore's funded social service agencies, providing valuable insights that can be implemented globally. The research underscores several key aspects of data security, including the effectiveness of incident response strategies, employee training, collaboration, and the integration of robust security protocols. These recommendations are based on the current research and lessons learned from the findings, which not only apply to the Singaporean context but also offer valuable guidance for social service agencies and organisations worldwide.

One of the key recommendations that arises from the research is the importance of regular, comprehensive cybersecurity training for all employees. As the research has shown, human error continues to be one of the most common vulnerabilities in cybersecurity. Across the globe, organisations must focus on regularly educating their employees, not just on the technical aspects of cybersecurity, but also on behavioral aspects such as recognizing phishing attempts, understanding the importance of secure communication, and following best practices for maintaining secure passwords. Globally, organisations should make cybersecurity training a continuous process and ensure that training programs are regularly updated to account for new threats. As evidenced by the findings, agencies that have strong training programs are more likely to be equipped to mitigate the risks posed by human error, and this recommendation should be universally adopted to reduce the impact of human mistakes on data security.

Developing and refining incident response strategies is another crucial recommendation drawn from the research. The findings from Objective 2 indicate that a significant majority of agencies believe they have quick incident response mechanisms in place. However, there remains some uncertainty regarding the speed and effectiveness of response times in certain agencies. The research suggests that organisations across the globe need to further enhance their incident response protocols to ensure that they can effectively mitigate the impact of data breaches. This includes creating a clear and well-documented response plan, providing regular drills for staff to practice in response to cybersecurity incidents, and ensuring rapid communication between departments to facilitate an effective response. Agencies should also ensure that their incident response strategies are regularly tested and updated to adapt to emerging threats such as ransomware and advanced persistent threats (APTs).

The research also highlights the importance of collaboration between organisations to strengthen data security. A significant portion of the research findings pointed to the value of inter-agency collaboration in the context of resource sharing and knowledge exchange. While agencies in Singapore expressed mixed opinions about sharing cybersecurity resources, the findings suggest that a collaborative approach can help address gaps in resources, expertise, and technological infrastructure. Globally, it is crucial that organisations prioritise the development of secure collaboration channels to enable the sharing of best practices, tools, and threat intelligence. This collaboration should focus not only on sharing resources but also on jointly developing threat intelligence networks to tackle common challenges faced by multiple agencies. Partnerships across sectors, both public and private, can foster a more resilient cybersecurity ecosystem.

In line with the global recommendation for improving access control practices, organisations worldwide should implement strict access controls based on the Principle of Least Privilege (PoLP), as indicated by the research. The research findings suggest that most organisations have the necessary tools and technology for data security, yet challenges remain regarding their ability to maintain updated security infrastructure. Organisations must enforce stringent access controls, ensuring that only those with the necessary clearance have access to sensitive data. Additionally, regular audits of access permissions should be conducted, and real-time monitoring of user activity should be established to identify unauthorized access attempts.

Furthermore, investing in technology plays a critical role in fortifying cybersecurity measures. The findings from Objective 1, which highlight that many agencies in Singapore face challenges related to insufficient resources and outdated technology, apply to organisations globally. Agencies must invest in modern security technologies such as endpoint protection, firewalls, intrusion detection systems (IDS), and data encryption tools. As cyber threats evolve rapidly, it is crucial that organisations do not rely on outdated systems but instead upgrade their infrastructure to incorporate advanced, automated security solutions capable of detecting and preventing cyberattacks proactively. Organisations must also develop a comprehensive data loss prevention (DLP) strategy, ensuring that sensitive data is encrypted both at rest and in transit.

Data sensitivity has emerged as a critical issue in the context of collaboration. The findings from Objective 4 indicate that many agencies perceive data sensitivity as a barrier to sharing information with other organisations. The global recommendation here is to create a secure framework for data sharing, where sensitive data is protected by robust encryption and compliance with privacy laws such as the General Data Protection Regulation (GDPR) and

Singapore’s Personal Data Protection Act (PDPA). This includes the development of secure channels for inter-agency data exchange and guidelines for ensuring that sensitive data is handled appropriately, especially in collaborative efforts.

The importance of securing the use of personal devices is another recommendation that is increasingly relevant in the context of remote working. As highlighted in the research, the ongoing challenges related to staffing shortages and the increasing use of personal devices for work-related tasks require organisations to implement policies for secure device usage. This includes ensuring that devices used for work are adequately protected through encryption, multi-factor authentication (MFA), and the use of Virtual Private Networks (VPNs) when accessing organisational data remotely. In addition, organisations should adopt bring-your-own-device (BYOD) policies that include guidelines for securing personal devices to mitigate the risk of unauthorized access and data leakage.

One final recommendation that arises from the research findings is the need for regular compliance audits. The research has shown that many agencies feel confident about their compliance with data protection laws; however, some respondents were uncertain about their level of compliance or indicated difficulties in meeting regulatory requirements. This suggests that organisations globally should implement regular compliance audits to ensure adherence to regulatory frameworks. Agencies should also conduct periodic training on the requirements of data protection laws, ensuring that employees are well-versed in the legal implications of mishandling data and the necessary steps to maintain compliance.

6.4 Conclusion

This dissertation has provided a comprehensive analysis of the data security measures implemented by funded social service agencies in Singapore, shedding light on the challenges they face and evaluating the effectiveness of current strategies. The research highlighted that while there is general confidence in the effectiveness of data security protocols, challenges such as budget constraints, limited technical expertise, and difficulties in keeping up with rapidly evolving cybersecurity threats persist. Furthermore, the findings revealed that although most agencies have solid incident response plans, there remains room for improvement, particularly in regular updates and clear communication.

The study also emphasized the critical role of employee training in enhancing data security. Agencies that invest in regular training programs are more likely to mitigate human errors, one of the most common causes of data breaches. Additionally, fostering a strong cybersecurity awareness culture within organisations was shown to significantly contribute to the overall effectiveness of data security measures.

A key insight from the research was the recognition of the importance of collaboration among agencies to share resources, best practices, and overcome gaps in expertise. However, concerns over data sensitivity and security risks often hinder these collaborative efforts, suggesting that more secure frameworks for inter-agency cooperation are necessary.

The dissertation also explored how the findings from Singapore can be applied globally. The recommendations offered not only aim to enhance data security in Singapore's social service sector but also provide valuable insights for organisations worldwide. These recommendations focus on continuous training, strengthening incident response strategies, fostering collaboration, ensuring compliance with international regulations, and investing in technology. By implementing these measures, organisations globally can improve their ability to combat cybersecurity threats and safeguard sensitive data.

This research serves as a critical step toward enhancing the understanding of data security in social service agencies and offers a foundation for further studies that could explore the nuances of cybersecurity in other sectors or regions. The implications of this study underscore the need for ongoing investment in cybersecurity infrastructure and training, as well as the importance of international collaboration to effectively address the growing challenges of the digital age.

APPENDIX A:

SURVEY COVER LETTER

Enhancing Data Security in Social Service Agencies

Instructions:

"Thank you for participating in this questionnaire. Please indicate your level of agreement with each statement by selecting one of the following options:

- 1: Strongly Disagree
- 2: Disagree
- 3: Neutral
- 4: Agree
- 5: Strongly Agree"

If a question does not apply, you may skip it.

Section 1: Demographic Information

Please select or fill in the appropriate response.

1. **Agency Type**: What type of agency do you represent?
   - Options: Non-profit, Government-funded, Private, Community-based, Other (please specify)
2. **Agency Size**: How many employees does your agency have?
   - Options: 1-10, 11-50, 51-100, 101-500, 500+
3. **Funding Source**: What is your agency's main funding source?
   - Options: Government, Donations, Grants, Private, Other (please specify)
4. **Years of Operation**: How long has your agency been operating?
   - Options: <1 year, 1-5 years, 6-10 years, 11-20 years, >20 years
5. **Role in Data Protection**: What is your main role in data protection?
   - Options: IT Manager, Data Protection Officer, Administrator, Executive, Other (please specify)
6. **Cybersecurity Budget**: What is your annual budget for cybersecurity?
   - Options: <$10,000, $10,000-$50,000, $50,000-$100,000, >$100,000, Prefer not to disclose

7. **Data Incidents**: How often has your agency had data security incidents in the past year?
   - Options: Never, 1-2 times, 3-5 times, >5 times, Prefer not to disclose

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Section 2: Data Security Protocols

1. Our data security protocols effectively protect sensitive information.
2. Our protocols can address new cybersecurity threats.
3. New security protocols are hard to implement due to compatibility or staff issues.
4. We update our security protocols regularly to meet standards.

Section 3: Incident Response

1. Our agency has a comprehensive plan for data breaches.
2. We respond quickly to security incidents.
3. Preventive measures keep data breaches low.
4. We regularly improve our incident response strategies.

Section 4: Inter-Agency Collaboration

1. We share cybersecurity resources and knowledge with other agencies.
2. We use best practices from other agencies to improve security.
3. Collaboration helps us overcome resource and expertise gaps.
4. Data sensitivity limits our ability to collaborate with other agencies.

Section 5: Employee Training and Awareness

1. Staff receive regular training on cybersecurity and data protection.
2. Training has reduced data breaches due to human error.
3. Training programs are frequent enough to keep staff informed.
4. Our agency has a strong cybersecurity awareness culture.

Section 6: Regulatory Compliance

1. Our agency fully complies with data protection laws (e.g., PDPA).

2. Meeting regulatory data security requirements is challenging.
3. We have policies to ensure compliance with security regulations.
4. Our compliance measures effectively protect sensitive data.

Section 7: Resource Constraints

1. Our agency’s budget is enough to support cybersecurity measures.
2. We have the tools and technology needed for data security.
3. Funding and expertise limitations impact our data security.
4. Hiring and retaining skilled cybersecurity staff is challenging due to budget constraints.

APPENDIX B:
INFORMED CONSENT

Research title: enhancing data security protocols: an analysis of funded social service agencies in Singapore

Principal Investigator: My name is Azral Bin Mohd Yacob. I am a DBA learner at SSBM GENEVA. I am conducting a study and you are invited to participate.

Purpose of the Study:

The study examines cybersecurity practices, compliance, and challenges in funded social service agencies in Singapore. It analyzes data security protocols, threat management, and regulatory adherence while assessing incident response, employee training, and collaboration. Findings aim to enhance cybersecurity policies and resource-sharing strategies in the sector.

Procedures:

If you agree to participate, you will be asked to complete a structured survey. The survey will include questions about your experiences, preferences, and perceptions regarding health insurance marketing strategies. It will take approximately 15–20 minutes to complete.

Confidentiality:

All information you provide will be kept confidential and used solely for academic purposes. Your responses will be anonymized to ensure that no personally identifiable information is included in the study's results. The data will be securely stored and accessed only by the researcher and authorized personnel.

Potential Risks and Benefits:

There are no significant risks associated with participating in this study. Your participation will contribute to valuable insights into improving health insurance marketing strategies, which may ultimately benefit consumers and the industry.

Consent Statement:

By signing below, you confirm that you have read and understood the information provided above. You consent to participate in this study and allow the researcher to use your responses for academic purposes.

Participant's Name: ___________________________

Participant's Signature: _______________________

Date: _______________________________________

Researcher’s Signature: _______________________

Date: _______________________________________

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