

UNIVERSITY OF ESSEX
SCHOOL OF LIFE SCIENCES

MSc MARINE SCIENCE AND SUSTAINABLE DEVELOPMENT

TITLE OF PLACEMENT:
EXPLORING THE MENTAL HEALTH BENEFITS OF AQUARIUM KEEPING BY
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Date:10/09/2024

ACKNOWLEDGEMENTS

My profound gratitude goes to God who made all of this possible.

I would like to extend gratitude to my supervisor Laissue Philippe for his support and encouragement throughout my research. His positive feedback and guidance were the key to the completion of my project.

Special thanks to the Ornamental Aquatic Trade Association (OATA) for giving me the opportunity to undertake my project within its organisation. Also grateful to have worked in affiliation with pet stores in Colchester and its environs, most especially the Maidenhead Aquatics in Braintree and Jollyes pet store in Colchester. The experience has been invaluable to my personal and professional growth.

I am especially thankful to Matt and Emily of the OATA for their guidance, support and mentorship throughout my placement. Also, I would like to acknowledge the support of my colleagues and friends, especially my brother Ibrahim all the way from Nigeria for his never-ending support and guidance.

Lastly, I am deeply grateful to my family, most especially my parents, Jamiu and Omolola Amao for their never-ending love and support.

Thank you all for making this achievement possible.

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List of Abbreviations

- **PSS** – Perceived Stress Scale
- **GAD-7** – Generalized Anxiety Disorder-7
- **PHQ-9** – Patient Health Questionnaire-9
- **SPSS** – Statistical Package for the Social Sciences
- **ANOVA** – Analysis of Variance
- **SD** – Standard Deviation
- **X²** – Chi-Square
- **p** – p-value (probability value)
- **ART** — Attention Restoration Theory
- **REC** — Research Ethics Committee
- **OATA**— Ornamental Aquatic Trade Association

ABSTRACT

This research investigates the benefits of maintaining an aquarium and the effect on mental health. The specific focus of the research is on the maintenance of an aquarium and the perceived levels of stress in fish keepers and non-fish keepers. This study undertook a mixed-methods approach, combining qualitative interviews with quantitative surveys to understand exactly how aquarium environments improve attempts at stress reduction and overall well-being. The PSS, GAD-7, and PHQ-9 were used in the survey to evaluate participants' mental health. SPSS was used for data analysis, including Chi-Square tests and Linear-by-Linear Association tests to find significant relations among the variables regarding the number of fish species owned and time spent with aquarium maintenance in relation to the outcome regarding mental health.

Results indicated that fishkeepers maintained a moderate level of stress, but time used to care for their aquariums contributed significantly to their mental health. Conversely, the number of fishes kept at home did not result in considerable perceived levels of stress by the owners. However, there is a significant difference that diversity of fish species played in the online fishkeeper's state of mind, though no such trend was able to be found for the face-to-face respondents. The non-fishkeepers reported higher levels of stress than fishkeepers, thus reinforcing the theory that interaction with natural environments can have therapeutic effects.

The findings suggest that fishkeeping, but in particular regular activity and maintenance involved in the process, might be an excellent tool for managing stress and general mental well-being. Further research may wish to examine the longer-term impacts of

fishkeeping upon mental health and explore whether perceived emotional attachment to fish moderates the effects of fishkeeping on levels of stress.

INTRODUCTION

The relationship between Human well-being and the natural environment has been something of interest and investigation has begun scientifically for quite some time. Human exposure to natural settings, for example, parks, forests, and green spaces, has been shown in most studies to have positive impacts on different aspects of mental health and psychological functioning (Hartig et al., 2014; Ulrich, 1984). On this score, one natural environment that has attracted increasing attention is that of the aquarium, both the private home aquarium and the publicly displayed aquarium exhibit.

Explaining how aquariums could support mental health requires an understanding of the biophilia hypothesis, first outlined by the famous biologist E.O. Wilson (1984). The concept of biophilia suggests that throughout our evolutionary history as a species, and as part of the importance of nature for our development and survival, humans have a genetic tendency to seek out contacts with nature and other living systems. Studies have shown that exposure to natural elements, such as water, plants, and animals, can elicit positive human emotional, cognitive, and physiological responses (Kellert & Wilson, 1993).

Indeed, studies conducted specifically in the context of aquariums reveal that exposure relaxes an individual, cleaving levels of stress and anxiety, and even their mood and cognitive performance (Cracknell et al., 2016, 2018). The possible mechanisms for the mental health benefits with regard to aquariums are: nature sounds of running water, observing the different aquatic life, and watching fish and other sea creatures that are otherwise calming.

A growing body of research testifies that aquariums can be more than passively beneficial. Keeping fish, or the maintenance of a private home aquarium, as a hobby has also been associated with improved mental health. A sense of responsibility, the opportunity for creative expression, and the feelings of accomplishment associated with successfully maintaining a healthy aquarium ecosystem may all contribute to better mood, lower levels of stress, and life satisfaction of fishkeepers (Splan et al., 2019).



It also appears that the mental health benefits of aquarium environments are extending beyond individual-level effects to broader societal and public health importance. The aquarium exhibits in healthcare settings like hospitals and long-term care facilities can be calming for patients; therefore, these exhibits are associated with lower levels of stress and anxiety and even clinical benefits (Barker & Barker, 1988; DeSchriver &

Riddick, 1990). In the same way that aquariums became relevant in correctional facilities, they contributed to less aggressive behavior and improved mood among prisoners (Splan et al., 2019).

While this growing body of research into mental health benefits from aquarium environments is promising, several gaps and limitations exist in the current literature.

While most of the existing research has focused on the immediate and short-term effects of aquarium exposure, very few longitudinal studies have assessed longer-term impacts on mental health and well-being. Most of the research to date has been conducted either in the tightly controlled laboratory or clinical setting and thus raises concerns with regard to generalizability to real-world applications across diverse populations.

Also, the specific mechanisms underlying the mental health gains from aquarium environments are complex and less well understood. Particular features of the aquarium itself, such as size, range of diversity involved, and water movement, might affect the frequency and duration of interaction, along with individual differences in personality, cultural background, and prior experiences. Such factors may all contribute to variation in the psychological and physiological responses related to aquarium exposure (Cracknell et al., 2016, 2018).

The proposed study will extend the current literature by providing a comprehensive investigation of perceived mental health benefits associated with home aquarium-keeping and public aquarium exhibits. The research will, therefore, go on to investigate possible immediate psychological and physiological effects of exposure to aquarium settings in relation to the nature of such environments and mental health outcomes.

Furthermore, the mental health benefits of aquarium environments will be compared with those documented in other natural settings, such as green spaces and high-biodiversity environments, to tease out the unique contributions of aquarium-based interventions to mental health and well-being.

This may have the potential to feed into the development of evidence-based interventions and public health initiatives aimed at improving mental wellbeing and developing better connections between people and the natural world-attending to these identified research gaps and extending the current level of understanding regarding the mental health benefits from aquarium keeping.

Objectives

The primary objectives of this study are:

1. To evaluate the perceived mental/psychological health benefits associated with interacting with private home aquariums and public aquarium exhibits, as reported in qualitative and quantitative studies.
2. To examine the relationship between time spent interacting with/maintaining an aquarium and mental health outcomes.
3. To critically evaluate the strengths, limitations, methodological considerations, and gaps within the current body of literature on this topic.
4. To provide recommendations for future research directions, including the use of longitudinal studies, physiological and neuroimaging measures, exploration of potential moderators and mediators, and interdisciplinary collaborations.

LITERATURE REVIEW

In the last decades, there has been an increased interest in keeping private aquariums at home and visiting public aquaria displays either in large public facilities or private ones (Cracknell et al., 2016; Oransky et al., 2004; Woolway and Goodale, 2021). Aquatic environments of these types have gradually expanded beyond serving basic functions in either private settings or large public facilities and increasingly are being recognized for likely therapeutic benefits to mental health and psychological wellbeing. The aim of this review is to critically assess the literature documenting perceived mental health impacts associated with both private aquariums and public aquarium exhibits.

It will continue specifically to discuss how aquariums might alleviate some ailments like anxiety, stress, loneliness, and depression, among other mental ailments. Although there are many documented studies on the positive outcomes on mental health due to exposure to green spaces or areas of high biodiversity (Kuo and Barnes, 2019; Twohig-Bennett and Jones, 2018) have conducted a review of the available evidence to establish whether contact with aquatic lifeforms and underwater scapes independently confers benefits, irrespective of site.



*Numerous studies have shown the mental health benefits associated with watching
fishes swim*

(Image source: Vecteezy free stock images)

It also examines whether benefits vary between fish keepers-i.e., those people maintaining private aquariums, taking fishes as pets-and non-fish keepers, and between frequent visitors and those with limited exposure to public aquarium facilities. Characteristics such as the number of aquariums, number of species kept, length of time in the hobby, and number of visits will be considered to establish whether any might influence the potential benefits.

These provide the two primary theoretical underpinnings: the biophilia hypothesis by (Wilson , 1984) and the attention restoration theory by (Kaplan, 1995) for assumed mental health benefits resulting from aquarium environments. It is expected that this review, synthesizing literature on the topic, might be informative not only to advance academic

discourses but also practical ones that pertain to the design and implementation of therapeutic intervention associated with aquarium environments.

Theoretical Framework

The potential mental health benefits associated with aquarium keeping can be understood through the lens of two prominent theoretical frameworks: the biophilia hypothesis and the attention restoration theory. These theories provide valuable insights into the mechanisms through which exposure to natural environments, including aquatic ecosystems, may positively influence human well-being.

The Biophilia Hypothesis

The biophilia hypothesis, as originally put forth by E.O. Wilson in 1984, purports that humans have an instinctive love for other forms of life and natural environments (Wilson, 1984). Following this perspective from an evolutionary perspective, the human species has evolved a genetic predisposition toward desiring connections with nature because our survival and well-being have been intimately linked to the natural world throughout our evolutionary history. As such, this hypothesis suggests that contact with nature elements can be beneficial for psychological well-being by satiating the hard-wired need for biophilic experiences (Kahn, 1997).

Empirical evidence for the biophilia hypothesis comes from a number of studies indicating that visiting natural environments has positive effects on various measures of mental health (Berto, 2014; Kuo and Barnes, 2019). As the biophilia hypothesis would predict, observing and interacting with aquatic life forms and their respective environments could

potentially evoke biophilic responses and improve mental health outcomes (Clements et al., 2019).

Attention Restoration Theory

Complementing the biophilia hypothesis, the attention restoration theory provides another way of looking into the possible mental health benefits of aquarium environments. The ART, developed by R. and S. Kaplan in the 1980s, theorizes that exposure to natural environments can help restore attentional capacities and reduce mental fatigue (Kaplan, 1995).

This theory postulates that natural environments with plenty of inherently interesting stimuli draw effortless attention, so directed attention can rest and replenish itself (Berto, 2005). This attentional restoration has been linked with reduced mental fatigue and symptomatology (Kaplan, 1995). Given the dynamic movements of fish and/or the play of light and shade, together with complex underwater landscapes, a captivating and restorative experience might occur that would help in improving cognitive functioning and reducing mental fatigue (Berto, 2005; Kuo and Barnes, 2019).

These theoretical frameworks put complementarities on the possible mechanisms by which aquarium environments may confer mental health benefits.

Literature Review Methodology

A comprehensive literature search was conducted to identify relevant studies examining the mental health impacts associated with private aquariums and public aquarium exhibits. The databases systematically searched include PubMed, PsycINFO, Google Scholar, and ResearchGate. The search strategy involved a combination of keywords

and terms such as "aquarium keeping," "home aquarium," "public aquarium," "mental health," "psychological well-being," "stress reduction," "anxiety," "depression," "biophilia," and "attention restoration."

The selection of studies was guided by specific criteria: direct relevance to the research questions, priority given to studies published within the past 20 years, inclusion of peer-reviewed journal articles and reputable conference proceedings, and a focus on empirical studies with quantitative, qualitative, or mixed-methods designs. Studies solely involving non-human animal subjects were excluded.

The study selection process involved an initial screening of titles and abstracts, followed by a full-text review of potentially relevant studies. This process was conducted independently by two researchers, and any discrepancies were resolved through discussion and consensus.

Additionally, a focused review of literature on survey design, data collection methods, and analysis techniques was undertaken to explore best practices for conducting surveys and gathering data on the perceptions and experiences of aquarium enthusiasts, non-aquarium owners, and visitors to public aquarium facilities.

Particular attention was given to studies examining potential explanatory variables influencing the mental health benefits of aquarium interactions, such as the number of aquariums owned, species diversity, duration of the hobby, and frequency of visits.

By employing this rigorous and systematic approach, the literature review aimed to provide a comprehensive synthesis of the current state of knowledge while laying the groundwork for future empirical research in this area.

Thematic Analysis

The thematic analysis of the literature is structured around four key areas that are central to understanding the mental health impacts of aquarium environments, both in private home settings and public aquarium exhibits.

Perceived Mental Health Benefits

Among the listed psychological benefits of exposure to aquariums are the decrease in stress and anxiety levels, mood improvement, and the mitigation of symptoms related to states of depression and loneliness. Therefore, research on home aquariums has underlined their deliverable positive impact, from reducing the scale of stress and anxiety to improving mood and mitigating symptoms related to states of depression and loneliness (Oransky et al., 2004; Clements et al., 2019).

Indeed, a qualitative study reported that home aquarium owners themselves described relaxation, pleasant mood feelings, and even stress reduction when viewing their fish (Oransky et al., 2004). Another recent systematic review stated the notion that some evidence does exist supporting exposure to fish in aquariums being related to increased human health and welfare regarding positive mood, probably accompanied by anxiety and stress reduction (Clements et al., 2019).

Positive psychological outcomes that arise from visiting public aquarium displays have also been documented in various research studies (Woolway and Goodale, 2021; Cracknell et al., 2016). In this regard, the study by Woolway and Goodale dealt with the restitution effects among visitors to public aquariums. Their findings indicated that there was a significant decline in the self-reported anxiety and/or stress of participants

immediately after visiting and viewing the public aquarium displays. There were also an enhanced mood and heightened sensations of tranquility or relaxation. In addition, research has documented that exposure to the ocean-in the artificial conditions of a public aquarium-can foster enhanced awareness coupled with the accrual of positive personal attitudes toward marine conservation efforts and, therefore, can contribute to the development of a sense of psychological well-being and environmental connectedness (Cracknell et al., 2016).

Physiological Effects and Measurement

While many of the studies rely on self-reported measures of mental health outcomes, a number of them have attempted to quantify the physiological effects of aquarium interactions through objective measures by considering heart rate variability, blood pressure, and cortisol levels as markers of plausible effects related to stress reduction and restorative effects of aquarium environments (Katcher et al., 1984; Cracknell et al., 2017; Foran, 2020).

An experiment conducted by Katcher et al. (1984) involved participants who were made to watch aquarium fish for only a short period. The results showed that those persons had both lower resting blood pressure and heart rates compared to their matched control group, thus suggesting that even a short exposure to an aquatic environment can also induce physiological responses associated with relaxation or stress reduction. Such a finding by Cracknell et al. (2017) discovered that a visit to a public aquarium exhibit produced impressive declines in salivary cortisol levels, a biomarker of stress, among all adults and children tested, though especially marked in those particular individuals with heightened pretreatment stress.

However, there was a variation in the findings. For instance, the study by Foran (2020) measured the heart rate variability and skin conductance of the participants while observing home aquariums. No significant differences upon comparison with the control group was noted. These inconsistent findings indicate the need for further research to explain the physiological mechanism underlying mental health benefits due to aquarium environments.

Comparison to Green Spaces and High Biodiversity Environments

Several studies have drawn comparisons between the mental health benefits of aquarium environments and those associated with exposure to green spaces and environments with high biodiversity, such as parks, gardens, and natural landscapes (Kuo and Barnes, 2019; Cracknell et al., 2016; Woolway and Goodale, 2021).

Kuo and Barnes (2019) synthesized evidence suggesting that exposure to nature and green spaces can promote psychological well-being through various pathways, including stress reduction, improved mood, and enhanced cognitive functioning, aligning with the potential benefits observed in aquarium environment studies. Cracknell et al. (2016) explored this connection by examining the impact of marine biome awareness, fostered through experiences like visiting public aquariums, on attitudes towards marine conservation, finding that increased awareness and positive attitudes were associated with higher psychological well-being, drawing parallels with terrestrial green space benefits.

Furthermore, Woolway and Goodale (2021) directly compared the restorative effects of visiting a public aquarium with those of spending time in a botanical garden, revealing

comparable levels of stress reduction and mood improvement in both environments, suggesting aquarium exhibits may offer similar therapeutic benefits to green spaces. However, factors such as the diversity and abundance of marine life, the quality and design of the exhibits, and the overall visitor experience may influence the extent to which aquariums can replicate the benefits of natural, high-biodiversity environments.

Differences Between Fish keepers and Non-Fish keepers

Consequently, while there is literature covering the mental health benefits of aquarium environments for both fish keepers-that is, those people who maintain private home aquariums and take fish as pets-and non-fish keepers, debates remain on whether such benefits from aquaria differ between fish keeper and non-fish keeper groups (Oransky et al., 2004; Kidd and Kidd, 1999; Woolway and Goodale, 2021).

Several studies have pointed out that aquarium owners benefit more in terms of mental health due to their more intense involvement with the maintenance and care required to keep the aquatic environment healthy (Oransky et al., 2004). In the study of Oransky et al. (2004), researchers compared relaxation and calmness between fish owners and non-fish owners and found that owners of fish enjoyed a better sense of calm and serenity, possibly because of the therapeutic effects of tending to their aquatic pets. Similarly, one qualitative research showed that the keeper may sometimes attach to the fish emotionally, which can further encourage company and reduce loneliness feeling (Kidd and Kidd, 1999). Once a person becomes attached to an aquarium emotionally and personally, the probability of his improved mental health may increase.

However, more recent work suggests the benefits of simply viewing and interacting with aquarium settings can be just as great for those who do not keep fish themselves (Woolway and Goodale, 2021). Studies by Woolway and Goodale (2021) indicated that both public aquarium visitors and those observing home aquariums reported similar levels of stress decrease and mood enhancement when considering the effects that active fishkeeping may not be necessary to produce therapeutic effects from exposure to an aquatic environment.

Degrees of mental health benefits within the group of fish keepers may vary according to several factors, such as the number of aquariums kept, variety in fish species, length of time as a hobbyist, and level of participation or activity in the care of the aquarium(s). These become possible explanatory variables which merit further investigation for a stronger understanding of active fishkeeping as a mitigator of mental health outcomes.

This thematic analysis synthesizes literature related to the perceived mental health benefits of aquarium environments, the underlying physiological mechanisms that may contribute to such benefits, comparisons with green space and high biodiversity environments, and differences between fish keeper versus non-fish keepers. The empirical evidence provided suggests very promising therapeutic potential that requires further research given the gaps and contradictions in the knowledge base.

Critical Evaluation

While the existing literature provides valuable insights into the potential mental health benefits associated with aquarium environments, it is essential to critically evaluate the strengths, limitations, and methodological considerations of the reviewed studies. This

critical analysis will not only highlight areas that require further investigation but also inform the design and execution of future research in this domain.

Strengths and Limitations

One of the strengths of the literature at the moment is methodological diversity; hence, one finds qualitative studies (e.g., Oransky et al., 2004; Kidd and Kidd, 1999) running abreast with quantitative ones (e.g., Woolway and Goodale, 2021; Cracknell et al., 2017), including even systematic reviews (e.g., Clements et al., 2019; Kuo and Barnes, 2019). This gives a comprehensive view of the phenomenon through a methodological triangulation that offers self-reported experiences combined with objective physiological measurements and syntheses of existing evidence.

Many of these studies also attained their results through solid experimental designs, such as randomized controlled trials (Woolway and Goodale, 2021) and within-subject comparisons (Katcher et al., 1984), which strengthen internal validity and reliability.

However, there are certain limitations that have to be considered in the available literature and certain sources of bias. Many of these studies used self-report measures of mental health outcomes susceptible to subjective biases and social desirability factors (Woolway and Goodale, 2021). Other research has been based on small samples or has used convenience sampling, instances in which generalizability may be problematic (Foran, 2020).

Another problem may be the presence of confounding variables which then have an impact on the overall effects that are observed. For instance, in the research carried out in a setting like public aquariums, it is noted that the overall visitor experience, interaction

with staff or even educational programs, and designs targeting specific exhibits may differentially have impacts on mental health, thus making it hard to isolate the specific effects of the aquarium environment itself (Cracknell et al., 2016).

Methodological Considerations

Several methodological considerations should be addressed in future research to strengthen the evidence base and advance our understanding of the mental health impacts of aquarium environments.

First, there is a need for larger-scale, longitudinal studies that track the potential mental health benefits over extended periods of time. Most existing studies have focused on short-term effects, leaving questions about the durability and long-term sustainability of these benefits unanswered.

Second, the incorporation of more objective and physiologically-based measures, such as cortisol levels, heart rate variability, and neuroimaging techniques, could provide valuable insights into the underlying mechanisms and biological pathways through which aquarium interactions may influence mental health (Cracknell et al., 2017; Foran, 2020).

Third, future studies should aim to explore and control for potential confounding variables and mediating factors. For instance, in the context of public aquarium exhibits, researchers could investigate the effects of exhibit design elements, educational programs, and visitor motivations to better isolate the impact of the aquarium environment itself.

Fourth, more research is needed to understand the potential moderating effects of individual differences, such as age, gender, cultural background, and pre-existing mental health conditions, on the perceived mental health benefits of aquarium environments.

Finally, the development and validation of standardized assessment tools and measures specific to the context of aquarium interactions would enhance the comparability and generalizability of findings across different studies.

Gaps and Contradictions

While the reviewed literature provides valuable insights into the research, several gaps and contradictions in the current body of knowledge warrant further investigation.

One notable gap is the limited research exploring the potential differences in mental health benefits between fish keepers and non-fish keepers, as well as the impact of factors such as the number of aquariums owned, the diversity of fish species, and the duration of the hobby (Kidd and Kidd, 1999; Oransky et al., 2004). A deeper understanding of these variables could shed light on the role of active participation and personal investment in the therapeutic potential of aquarium environments.

Additionally, there is a need for more research specifically examining the mental health impacts of public aquarium exhibits, as the majority of existing studies have focused on private home aquariums (Woolway and Goodale, 2021; Cracknell et al., 2016). Investigating the potential differences between these two contexts could inform the design and implementation of therapeutic interventions and educational programs in public aquarium settings.

Furthermore, the existing literature presents some contradictory findings regarding the physiological effects of aquarium interactions. While some studies have reported significant changes in physiological markers such as heart rate, blood pressure, and cortisol levels (Katcher et al., 1984; Cracknell et al., 2017), others have found no significant physiological effects (Foran, 2020). These contradictions highlight the need for further research to clarify the physiological mechanisms underlying the potential mental health benefits of aquarium environments.

By critically evaluating the strengths, limitations, methodological considerations, and gaps in the existing literature, this section provides a roadmap for future research endeavors. Addressing these issues will not only deepen our understanding of the mental health impacts of aquarium environments but also inform the development of evidence-based therapeutic interventions and educational programs that leverage the potential restorative properties of these unique environments.

Inference

The current literature review has merged the available research material on mental health impacts and health promotion linked to aquarium systems at homes with related medicinal values of such unique aquatic environments in the psychological well-being of the discipline of marine science.

Reviewed literature points to the fact that although designs and inputs varied, all the aquarium environments are able to confer mental health benefits, reduce stress and anxiety, improve mood and alleviate symptoms of depression and loneliness. This was

evidenced by both qualitative accounts of quantitative studies measuring physiological markers of relaxation.

The biophilia hypothesis (Wilson, 1984) and the attention restoration theory (Kaplan, 1995) offer theoretical explanations for the observed benefits. Additionally, parallels are drawn between the potential advantages of aquarium environments and those associated with exposure to green spaces and high biodiversity environments (Kuo and Barnes, 2019; Cracknell et al., 2016).

While the literature explores impacts on fish keepers (individuals maintaining private aquariums) and non-fish keepers, findings regarding potential differences between these groups remain inconclusive. Some studies suggest heightened benefits for fish keepers due to active involvement and emotional connections (Oransky et al., 2004; Kidd and Kidd, 1999), while others indicate non-fish keepers can also derive significant benefits from observation (Woolway and Goodale, 2021).

Future Research Directions

While this literature review has synthesized the existing knowledge on the mental health impacts of aquarium environments, some recommendations regarding future research could be advanced:

1. Longitudinal studies: It would be very interesting to do some longitudinal studies in order to get the durability and sustainability features of the supposed mental health benefits of aquariums.
2. Physiological and neuroimaging measures: The inclusion of objective physiological measures, such as cortisol levels, heart rate variability, and neuroimaging techniques,

would be able to provide a clear explanation of the biological mechanism and neural correlates underlying the mental health effects observed.

3. Exploring the potential moderators and mediators: Examine the potential moderating effect of individual differences (e.g., age, sex, cultural background, pre-existing mental health conditions), and mediating factors (e.g., exhibit design, educational programs, visitor motivations) that might assist in a better understanding of the main variables affecting the mental outcomes.

4 Comparative studies may be relevant to contrast the mental health impacts of private home aquariums with those of public aquarium exhibits, in order to shed light on how similarities and differences in contexts influence the design and implementation of therapeutic interventions in each setting.

5. Standardized assessment tools: Development and validation of standardized assessment tools and measures in the context of aquarium interactions would thus help in comparisons and generalizations between different groups of studies.

6. Interdisciplinary collaborations: Such interdisciplinary collaborations from researchers interested in topics such as psychology, environmental sciences, marine biology, and urban planning could facilitate a holistic approach to the impact of aquarium environments on human mental health.

By addressing these future research directions and building upon the findings of this literature review, the marine science community can deepen its understanding of the therapeutic potential of aquarium environments and contribute to the development of evidence-based interventions that promote mental well-being and resilience.

In conclusion, this literature review has provided a comprehensive synthesis and critical evaluation of the existing research on the mental health impacts of aquarium environments. While further investigation is warranted to address the identified gaps and limitations, the findings highlight the promising therapeutic value of these unique settings and their potential to enhance psychological well-being in diverse populations.

RESEARCH METHOD

This study utilized a mixed-methods approach, combining qualitative and quantitative data collection techniques to investigate the research objectives comprehensively.

Qualitative Phase:

1. Semi-structured interviews were conducted with both fishkeepers and non-fishkeepers to explore their perceptions, experiences, and views on the potential mental health benefits of aquarium keeping.
2. Thematic analysis was employed to identify emerging themes and patterns within the interview data.

Quantitative Phase:

1. A cross-sectional survey was administered to a sample of fishkeepers and non-fishkeepers to collect data on their mental health status, time spent interacting with aquariums, and other relevant variables.
2. Standardized psychological measures, such as the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), Generalized Anxiety Disorder-7 (Spitzer, Kroenke, Williams, & Löwe, 2006), and the Patient Health Questionnaire-9 (Kroenke, Spitzer, & Williams, 2001), was used to assess mental health outcomes.
3. Regression analysis was performed to examine the relationships between aquarium interaction, aquarium characteristics, and mental health variables.
4. Comparative analyses were conducted to compare the mental health benefits of aquarium environments with those associated with exposure to green

spaces and high-biodiversity environments, as reported in the literature (Barton & Pretty, 2010; Dadvand et al., 2015).

The Perceived Stress Scale (PSS) was adopted in this study to assess the mental health of the participants. This scale measures perceived stress by assigning a score based on responses ranging from 'Never' (0 points) to 'Very Often' (4 points). The participants' cumulative scores were then categorized into three stress levels using a percentage-based scale derived from the total possible PSS score:

- Participants scoring between 0 to 32.5% of the total score were classified as having low stress.
- Participants scoring between 32.6% to 65% were identified as moderately stressed.
- Participants scoring between 66% to 100% were considered to have highly perceived stress.

Further, standardized psychological measures such as the Generalized Anxiety Disorder-7 (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9) were used to assess mental health outcomes. The study was conducted in collaboration with The Ornamental Aquatic Trade Association (OATA), which provided guide and placement support to local pet shops and aquarium stores: Maidenhead Aquatics Braintree and Jollyes Pet store Colchester. The stores provided access to fishkeepers and other respondents for the quantitative survey through a combination of in-store advertisements, social media outreach, and referrals from store staff.

Analysis and Statistical Tools:

A Chi-Square test was employed to examine relationships between various variables, such as the number of fish species, ponds maintained, and time spent on aquarium maintenance, and mental health outcomes. In addition, Linear-by-Linear Association tests were used to assess the trends between these variables and mental health.

FINDINGS AND ANALYSIS

This section entails the findings of this study. It conducted a statistical analysis with a report of data interpretation for each finding. It contains the demographics of Respondents, Mental Assessment, and Aquarium details of respondents.

4.2 Demographics Data of Respondents

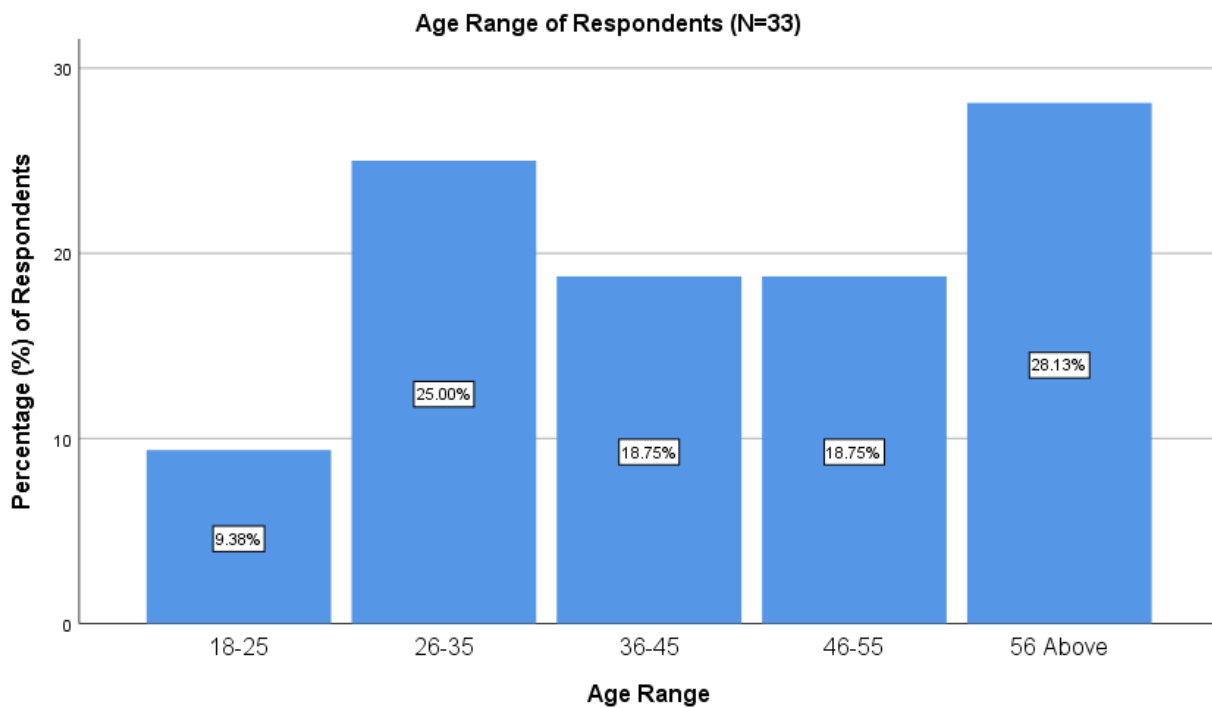


Figure 4.1: Fish Keepers (In-Person Respondents)

A total of 33 participants were physically engaged and filled out the printed questionnaire. Most of the in-person participants are 56 and above, while a large portion are also between 26 and 35 years old.

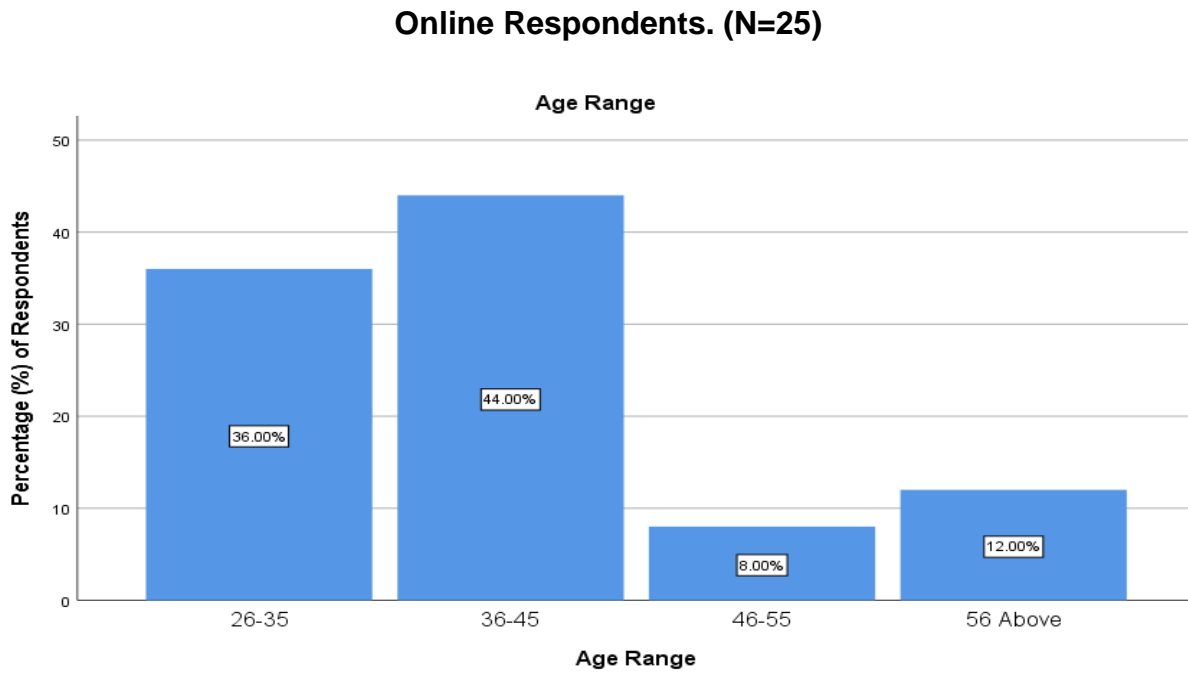


Figure 4.2: Fish Keepers (Online Respondents)

A total of 25 participants were recorded, and most were between 36 and 45 years old, with a larger proportion also between 26 and 35.

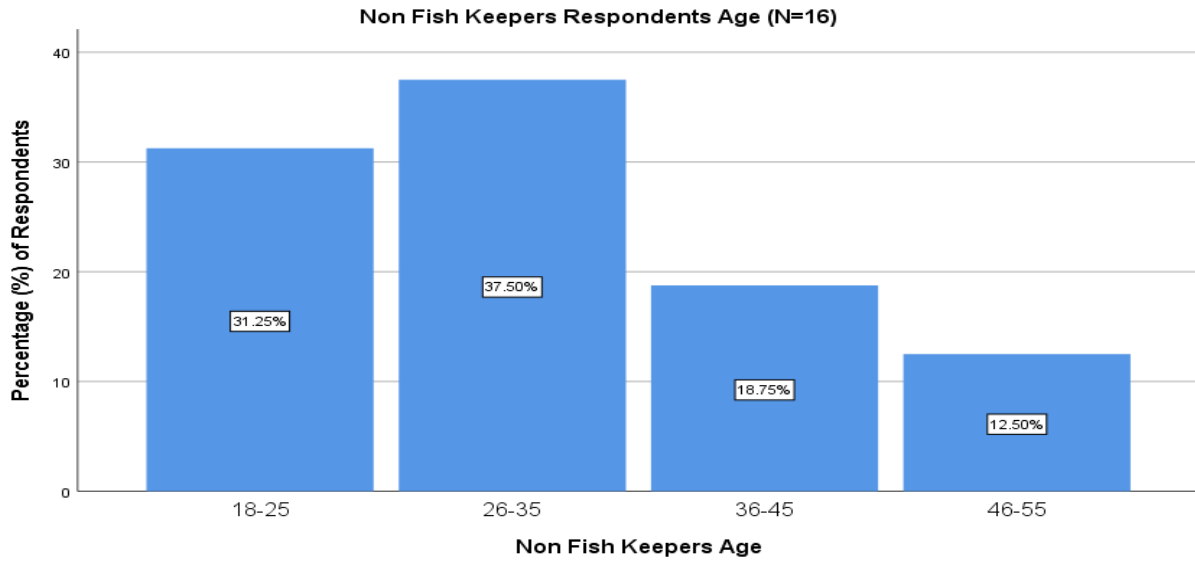


Figure 4.3: Non- Fish Keepers (In-person Respondents)

A total of 16 non fish-keepers were engaged physically. The result shows that most of the non-fish keepers were between the ages of 26 and 35, and a large proportion were also between the ages of 18 and 25.

4.2.1 Gender distribution of respondents

H1: There will be equal participation by all genders

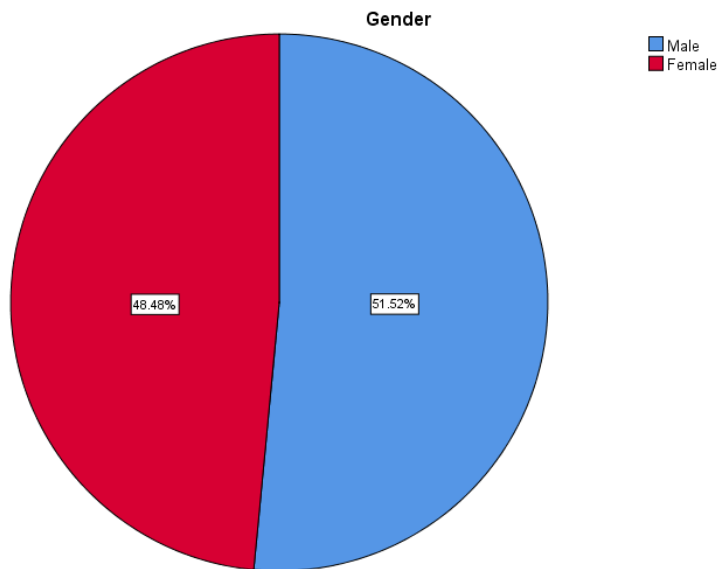


Figure 4.4: Fish Keepers (In-Person Respondents)

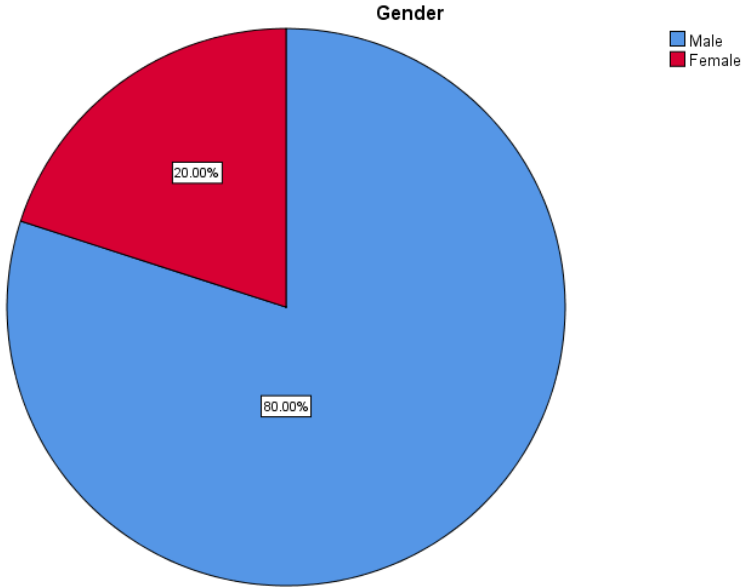


Figure 4.5: Fish Keepers (Online Respondents)

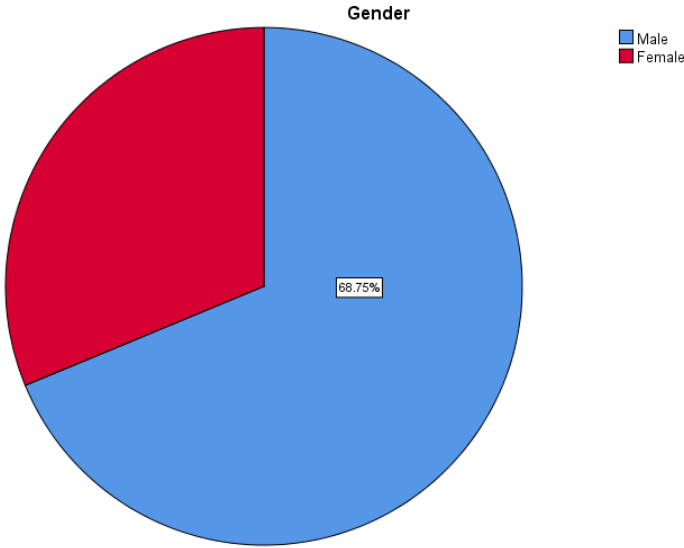


Figure 4.6: Non- Fish Keepers (In-person Respondents)

The overall result shows that there is no equal participation among respondents, such that more than half of the participants are male. However, there is almost equal participation among the in-person fish keepers, while the online participants clearly have more male participants than females. Also, the in-person non-fish keepers have mostly more males than females.

4.3 Participants Employment Status

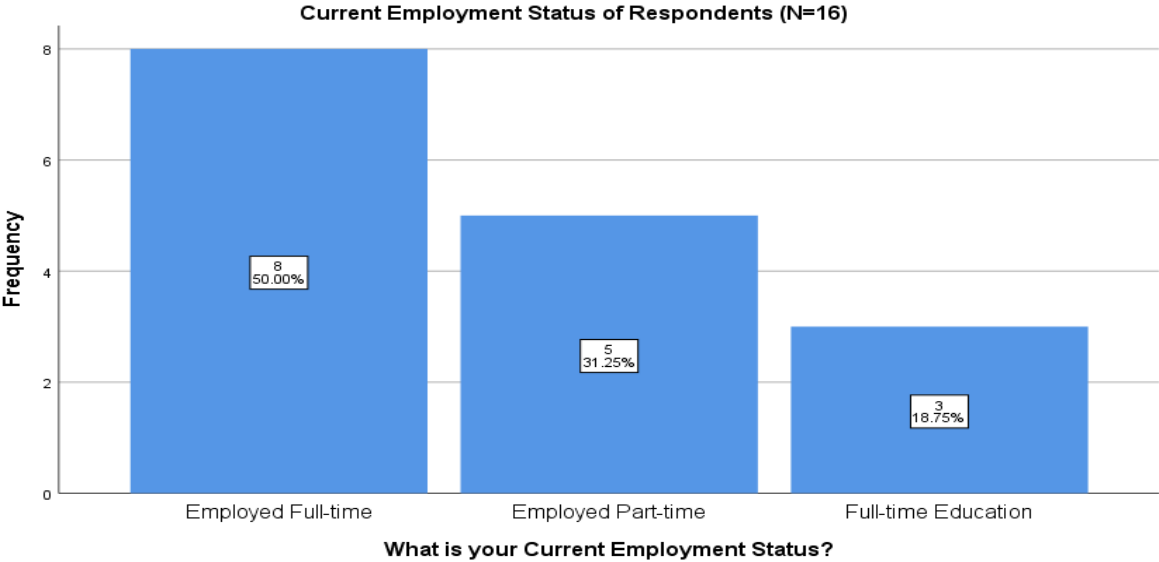


Figure 4.7: Employment status of Non-Fish Keepers (In-person Respondents)

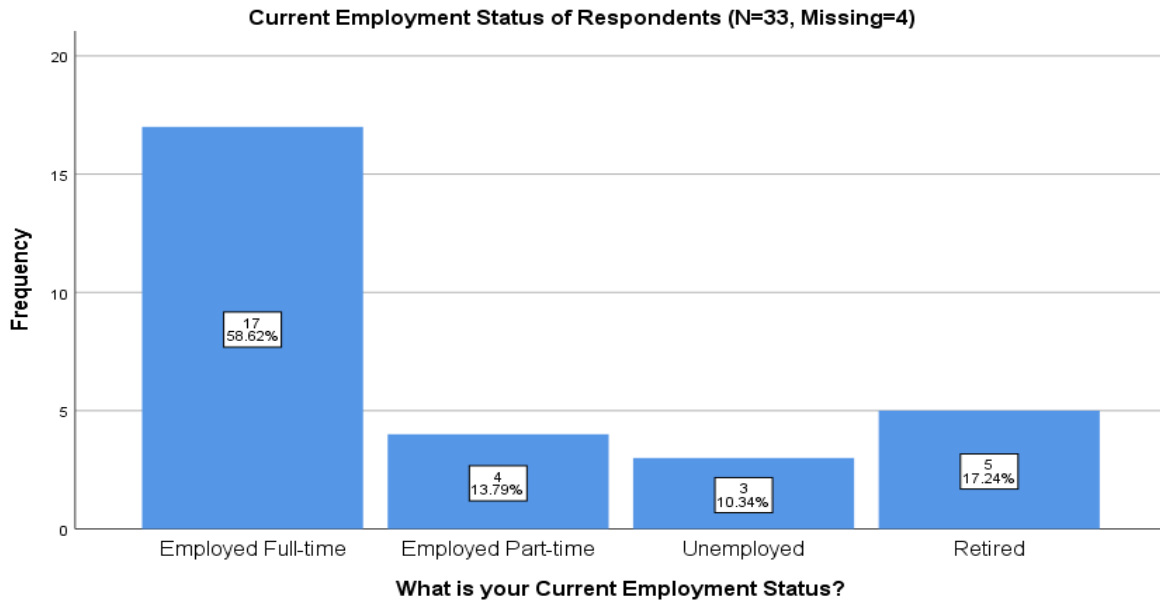


Figure 4.8: Employment status of Fish Keepers (In-Person Respondents)

Figures 4.7 and 4.8 show that both fish keepers and non-fish keepers are employed on a full-time job. While none of the non-fish keepers are retirees

4.4 Participants Activity Level

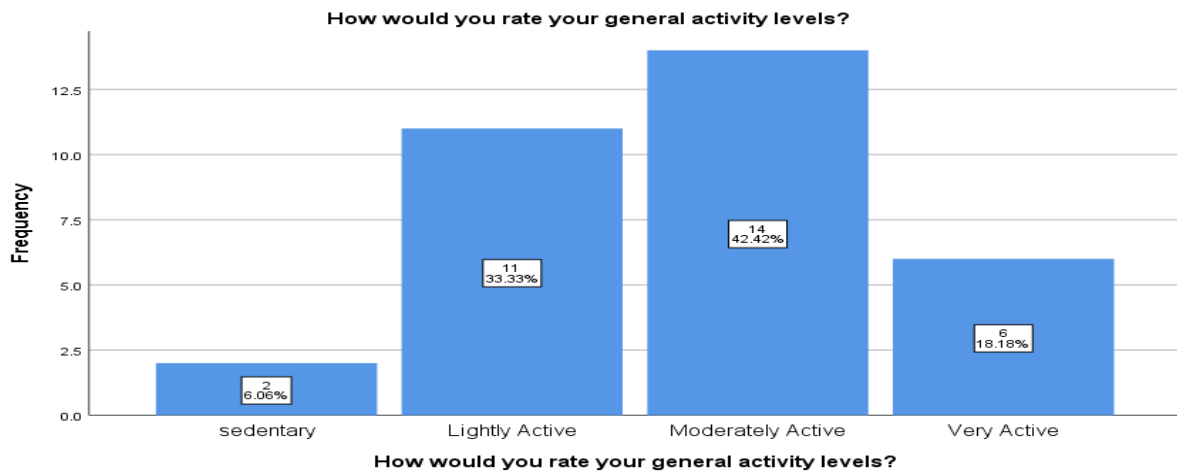


Figure 4.9: Fish Keepers (In-person Respondents) Activity level

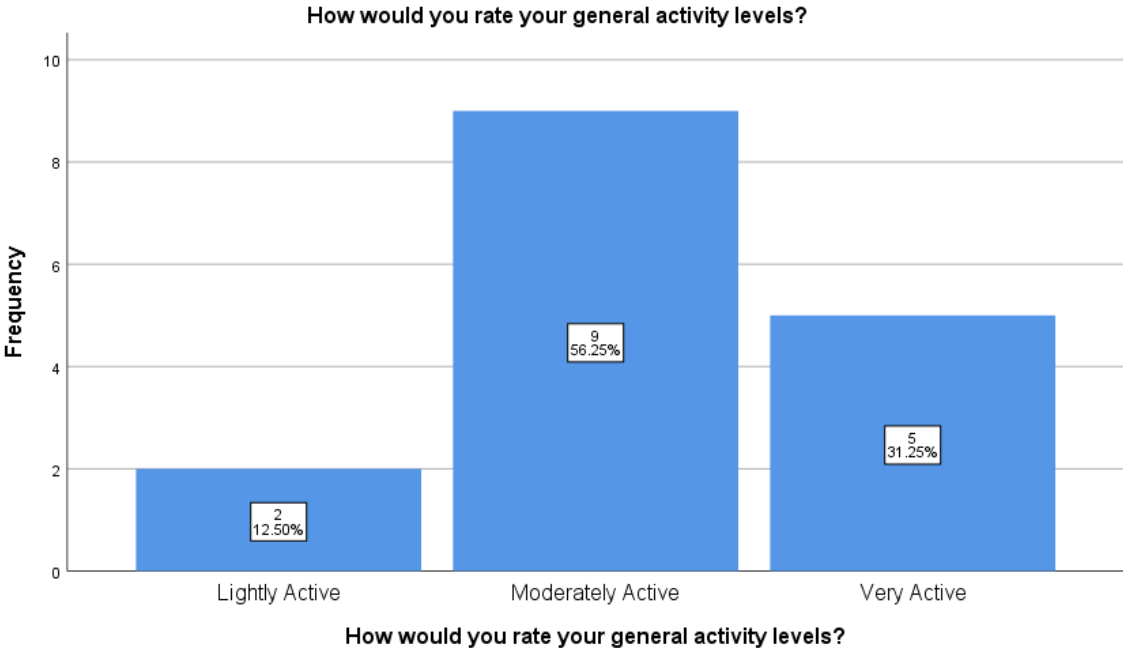


Figure 4.10: Non- Fish Keepers (In-person Respondents) Activity level

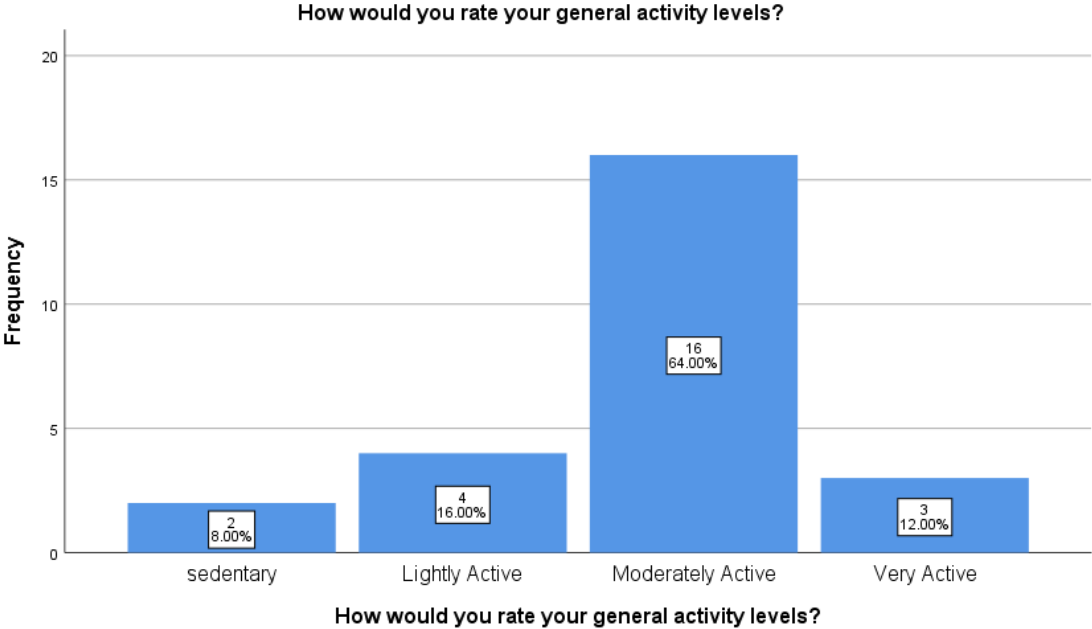


Figure 4.11: Fish Keepers (Online Respondents) Activity level

Overall, the result shows that most of the participants are moderately active, while a more significant percentage are also lightly active.

4.5 Pet Ownership among Aquarium Keepers

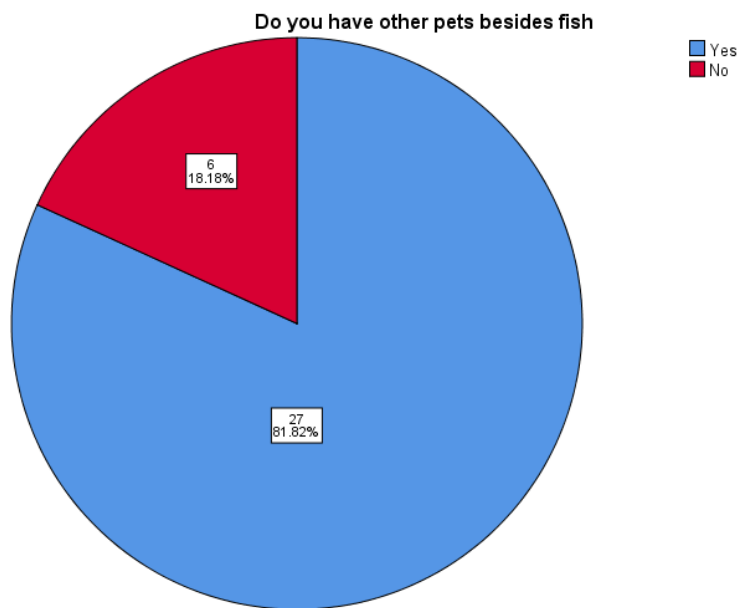


Figure 4.12: Fish Keepers (In-person Respondents) Pet Ownership

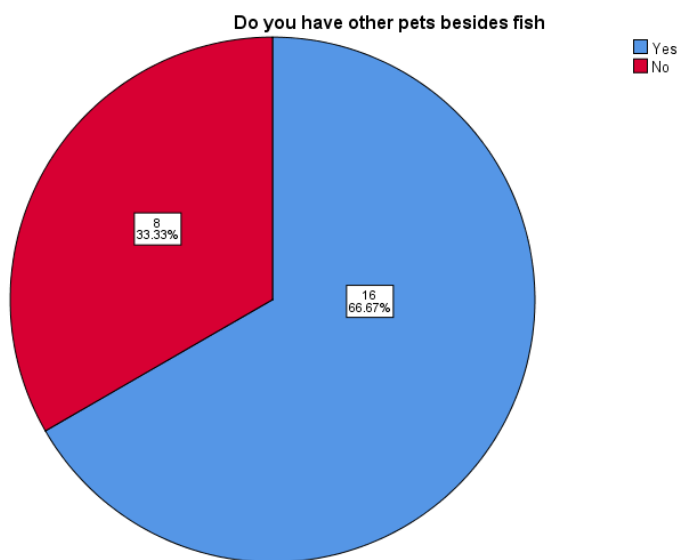


Figure 4.13: Fish Keepers (Online Respondents) Pet Ownership among Aquarium Keepers

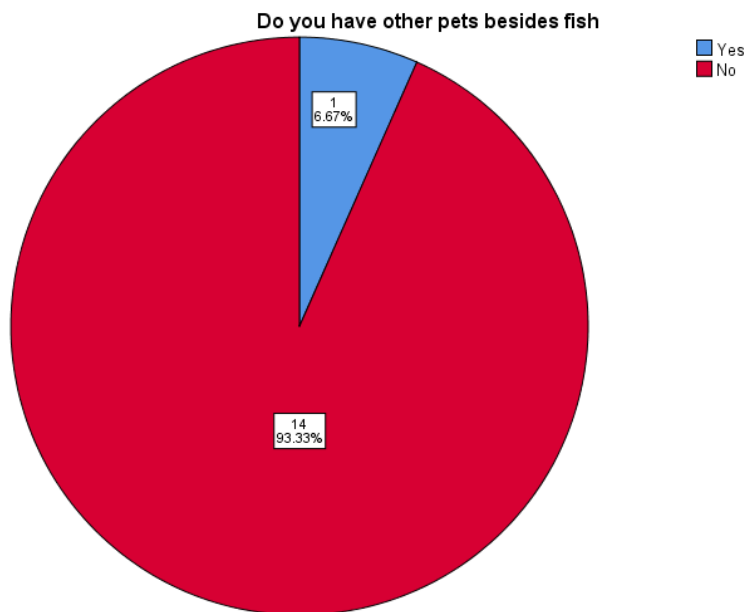


Figure 4.14: Non-Fish Keepers Pet Ownership

The result shows that most fish keepers have other pets, while most non-fish keepers do not.

4.6 Choice of Closing Aquarium

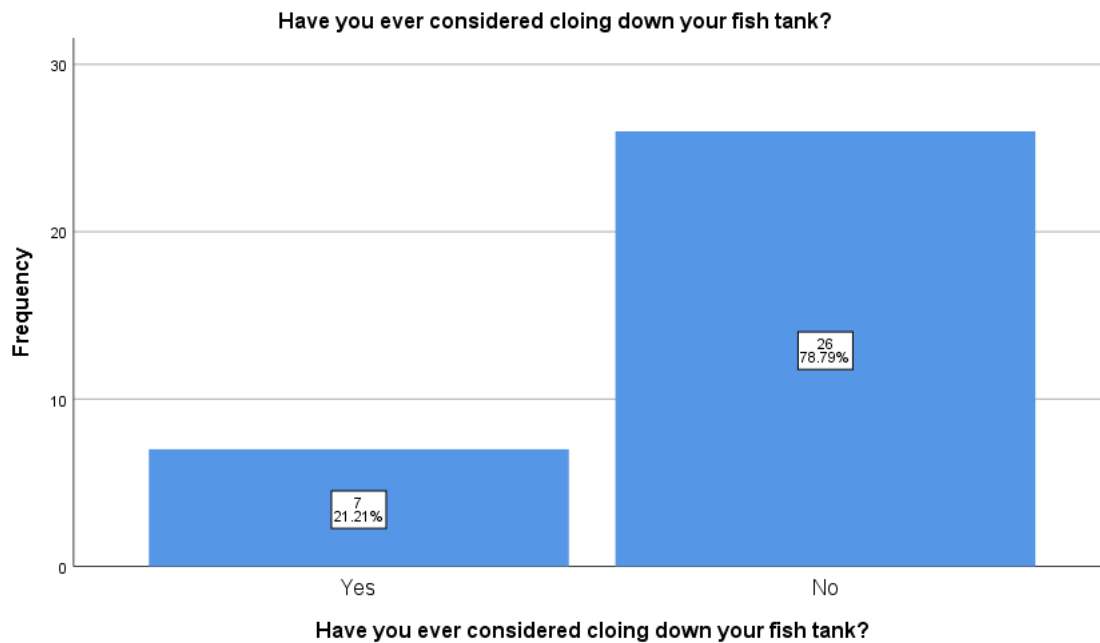


Figure 4.15: Fish Keepers (In-person Respondents) Choice of Closing Aquarium

The result shows that most of the fish keepers have never consider closing their aquarium.

4.7 Mental Health Assessment

Key: The fish keepers(in-person) questionnaire responses were coded in numeric and the cumulative scores ranges from 0 to 16. This shows the level of perceived stress which is based on these scores, participants were categorised into three groups: Low Stress (0-5.2), Moderate Stress (5.3-10.4) and Highly Perceived (10.5-16).

Table 4.1: Mental Health Score of Fish Keepers (In-Person)

Mental Health Score (Fish Keepers In-Person)

Category	Frequency	Percent
Low Stress	3	9.1
Moderate Stress	17	51.5
High Perceived Stress	13	39.4
Total	33	100.0

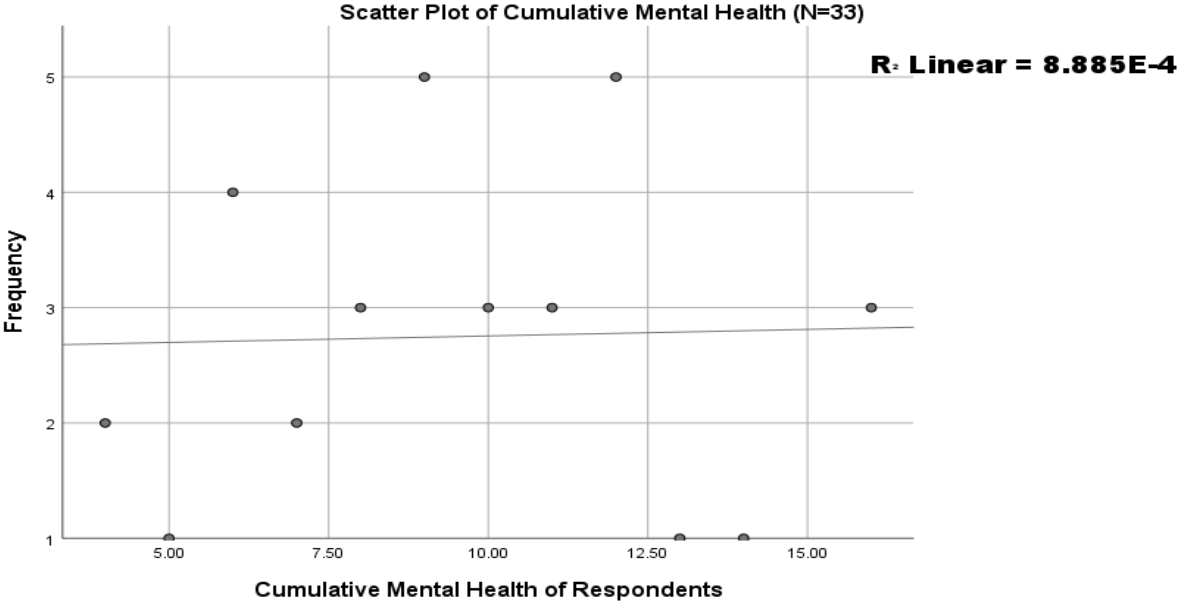


Figure 4.16: Mental Health Score (Fish Keepers In-person)

4.7.1 Mental Health Score of Fish Keepers (Online)

Key: The questionnaire responses were coded in numeric and the cumulative scores ranges from 0 to 8. This shows the level of perceived stress which is based on these scores, participants were categorized into three groups, which are Low Stress (0-2.6), Moderate Stress (2.7-5.6) and Highly Perceived (5.7- 8).

Table 4.2: Mental Health Score of Fish Keepers (Online)

Mental Health Score (Fish Keepers - Online)		
Category	Frequency	Percent
Low Stressed	1	4.0
Moderate Stress	23	92.0
Total	24	96.0
Missing	1	4.0
Total	25	100.0

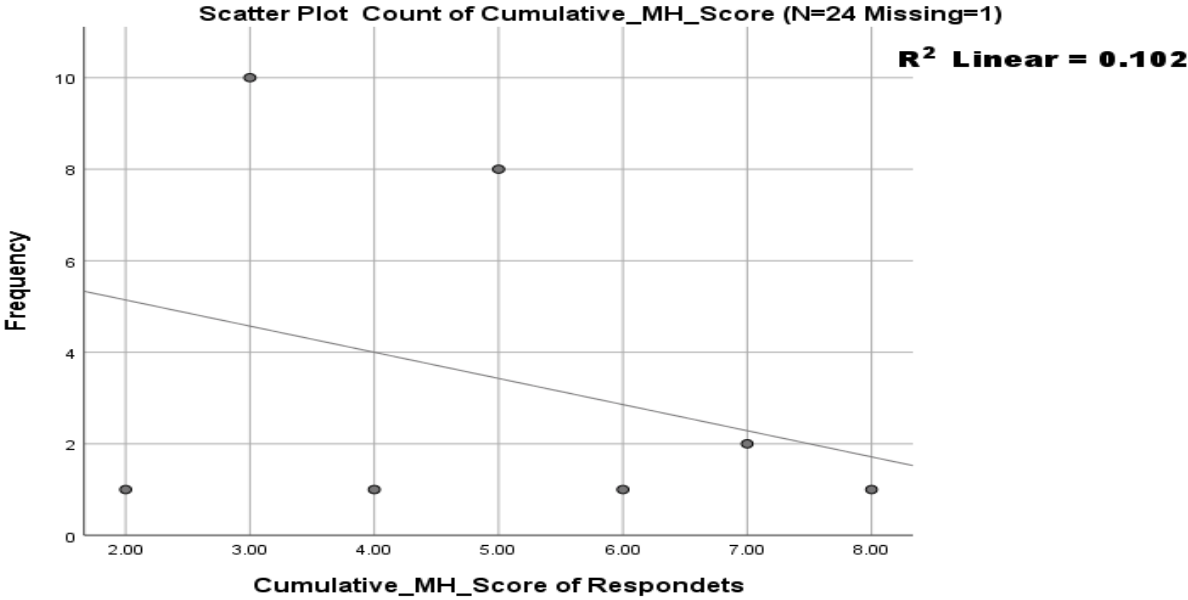


Figure 4.17: Mental Health Score of Fish Keepers (Online)

4.7.2 Mental Health Score of Non-Fish Keepers (In-Person)

Key: The questionnaire responses were coded in numeric and the cumulative scores ranges from 0 to 12. This shows the level of perceived stress which is based on these

scores, participants were categorized into three groups: Low Stress (0 - 3.9), Moderate Stress (4.0 - 7.8) and Highly Perceived (7.9 – 12.0).

Mental Health Category (Non Fish keeper In-Person)		
Category	Frequency	Percent
Low Stress	2	12.5
Moderate Stress	5	31.3
High Perceived	9	56.3
Total	16	100.0

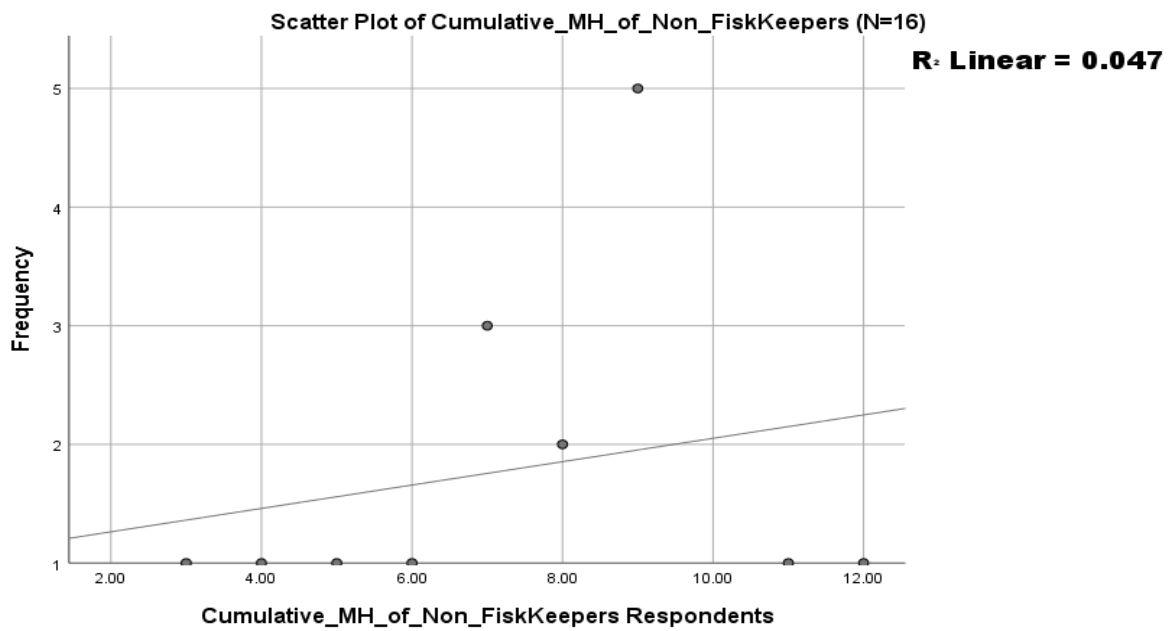


Figure 4.18: Mental Health Score of Non-Fish Keepers (In-person)

4.8 Test of Hypothesis

4.8.1 Numbers of pond/aquarium maintained

H₂: There is a significant difference in the mental health scores between participants with different numbers of pond/aquarium.

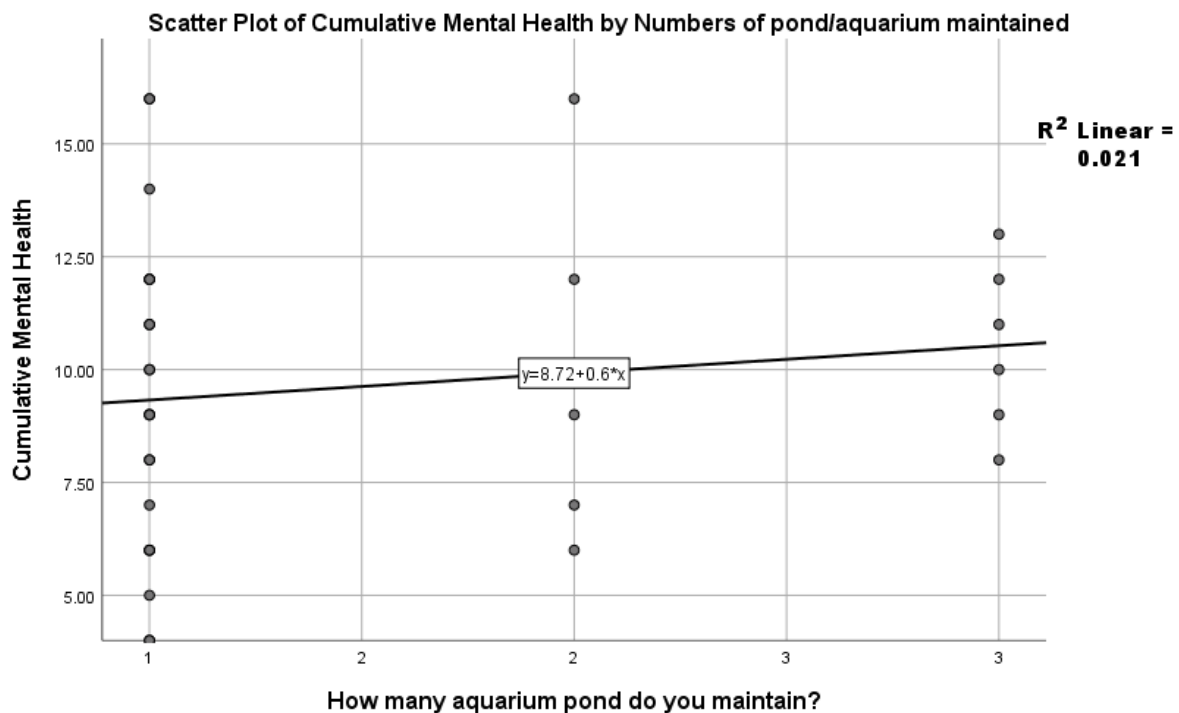


Figure 4.19: Numbers of pond/aquarium maintained and mental health scores of Fish Keepers (In- Person)

The Chi-Square test results showed no significant difference, $X^2(4, n=33) = 1.81, p = .771$. This means that the number of ponds or aquariums owned by fish keepers does not significantly affect their mental health scores. Also, the Linear-by-Linear Association test found no significant linear relationship between the number of ponds/aquariums

and the mental health scores as the Linear-by-Linear Association = .989, $p = .320$. This suggests that there is no consistent linear trend where an increase or decrease in the number of ponds or aquariums in relation with a change in mental health scores. The result shows that the number of ponds/aquariums owned did not have any impact on perceived mental health status of fish keepers.

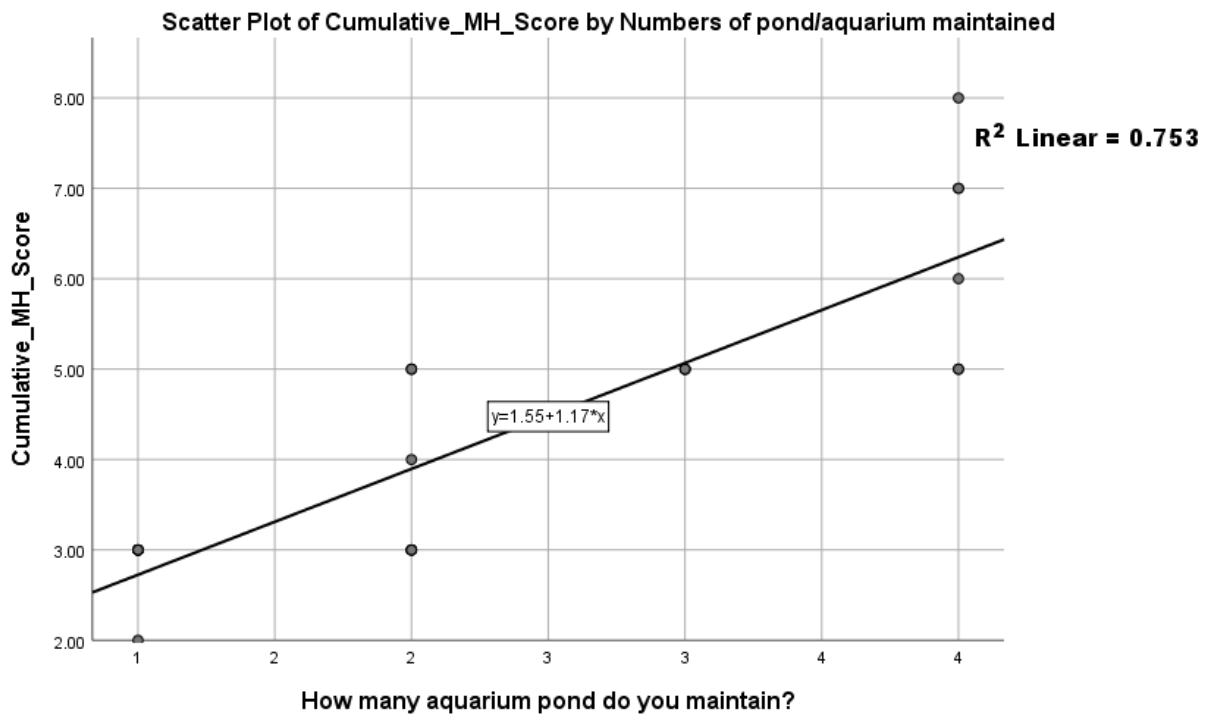


Figure 4.20: Numbers of pond/aquarium maintained and their mental health scores (Online)

The Chi-Square test results showed no significant association as $X^2(3, n=23) = 2.39$, $p = .496$ and (missing=2). This suggests that the number of ponds or aquariums does not significantly impact the mental health scores of the participants. The Linear-by-Linear Association test also shows no significant linear trend, Linear-by-Linear Association = 1.34, $p = .247$. This result indicates that there is no consistent linear relationship

between the number of ponds/aquariums and changes in mental health scores. This means that the number of ponds/aquariums owned did not have any impact on perceived mental health status of fish keepers that are online respondents.

4.8.2 Time spent on Aquarium Maintenance

H₃: There is a significant difference in the mental health scores between participants with different time spent on aquarium maintenance

Figure 4.21: Time spent on Aquarium Maintenance and mental health scores (In-Person Fish Keepers)

Using Chi-Square test, the results indicated a significant association, $X^2(4, n=33) = 14.05, p = .007$. This suggests that there is a significant difference in mental health scores based on the time spent on aquarium maintenance. Further, the Linear-by-Linear Association test showed a significant linear trend, Linear-by-Linear Association = 10.51, $p = .001$. This indicates a significant linear relationship, suggesting that the time spent on aquarium maintenance is in relation with changes in mental health scores.

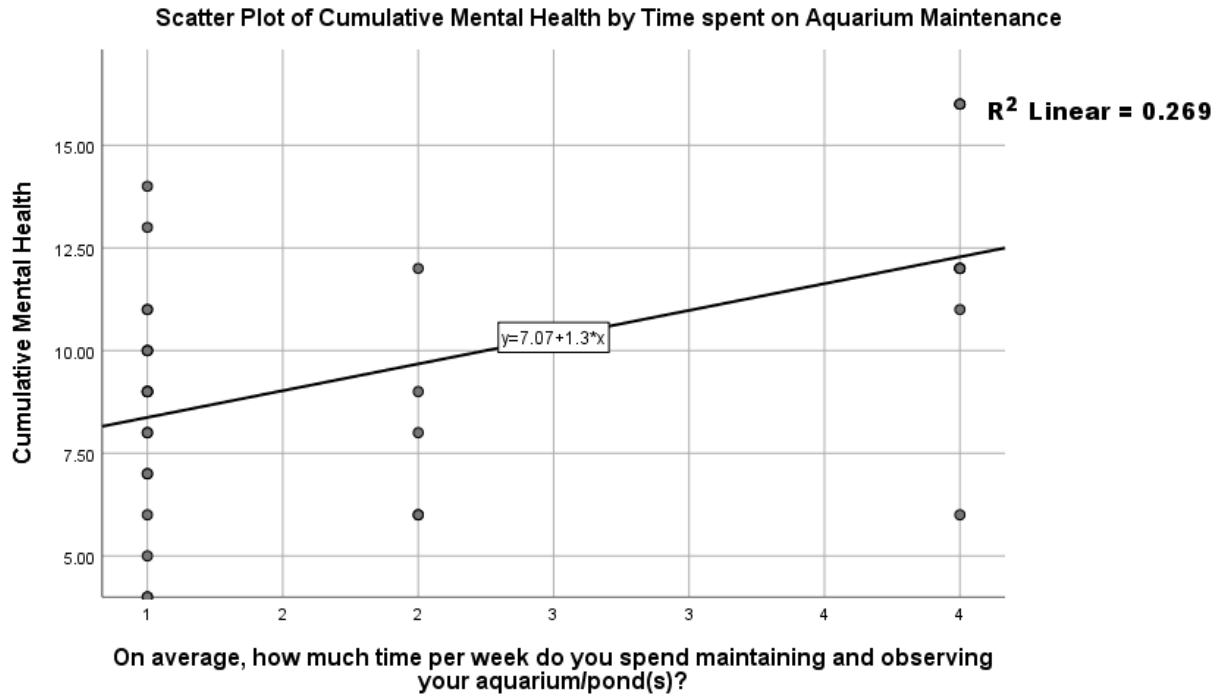


Figure 4.22: Time spent and mental health scores (Online)

The Chi-Square result indicated a significant association, $X^2(2, n=23) = 9.485, p = .009$.

This suggests that the time spent on aquarium maintenance has a statistically significant impact on the mental health scores of the participants. The Linear-by-Linear Association test also indicated a linear relationship as Linear-by-Linear Association = .002, $p = .965$. However, this result suggests that there is no linear trend between the time spent on aquarium maintenance and changes in mental health scores.

4.8.3 Total number of fish owned by fish-keepers

H4: There is a significant difference in the mental health scores between participants with different total number of fish owned by fish keepers

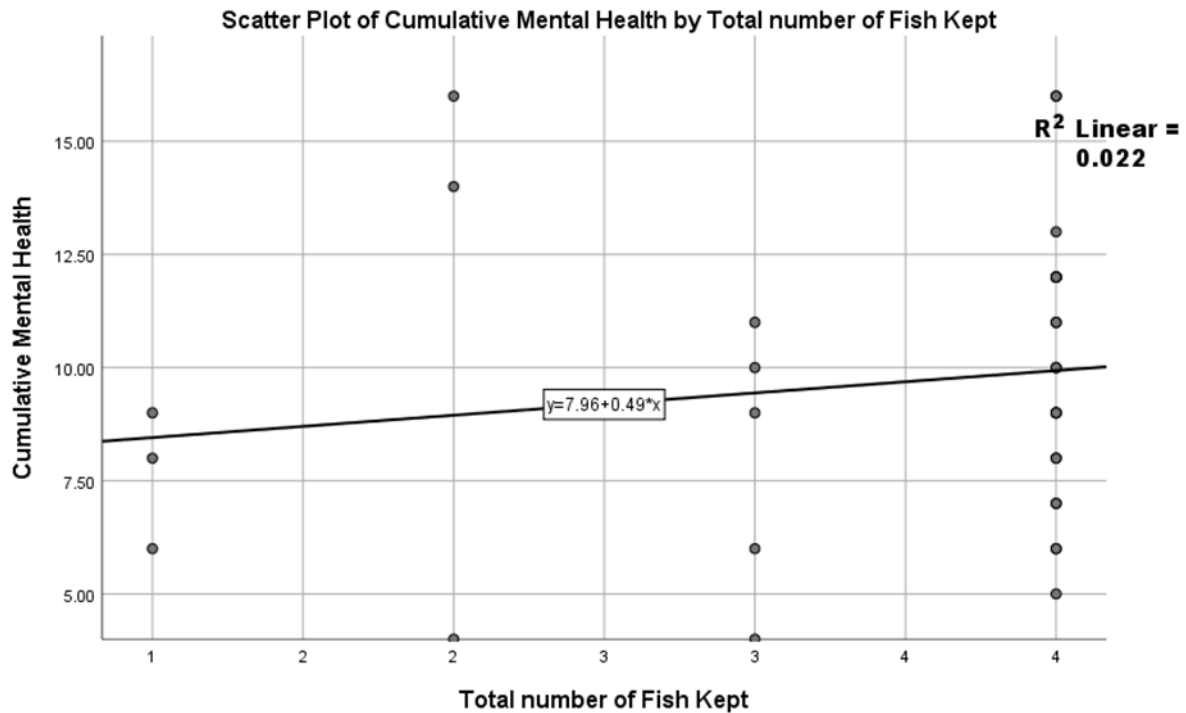


Figure 4.23: Total Number of fish kept and mental health scores (In-Person)

Chi-Square test results revealed that there is no significant difference, $X^2(6, n=33) = 8.79, p = .186$. This indicates that the total number of fish owned by participants does not significantly impact their mental health scores. Additionally, the Linear-by-Linear Association test showed no significant linear relationship, Linear-by-Linear Association = 1.276, $p = .259$. This suggests that there is no consistent trend where changes in the number of fish correlate with changes in mental health scores. The result shows that the number of fish species owned did not have any impact on perceived mental health status of fish keepers.

4.8.4 Number of fish species

H₅: There is no significant difference in the mental health scores between participants with different number of fish species

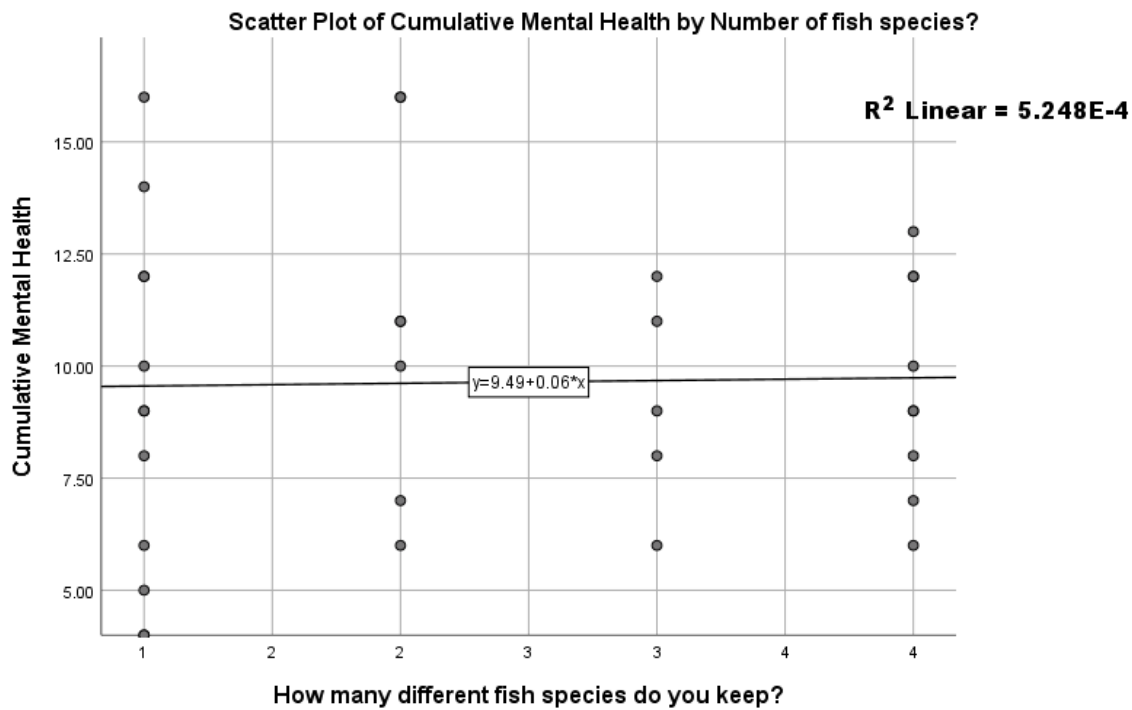


Figure 4.24: Numbers of fish species and mental health scores (In-Person)

Chi-Square test results showed no significant association, $X^2(6, n=33) = 6.81, p = .339$.

This suggests that the number of fish species does not significantly affect the mental health scores of the participants. Additionally, the Linear-by-Linear Association test also indicated no significant linear relationship, Linear-by-Linear Association = .672, $p = .412$. This result suggests that there is no consistent linear trend between the number of fish species and changes in mental health scores. The result shows that the number of fish species owned did not have any impact on perceived mental health status of fish keepers.

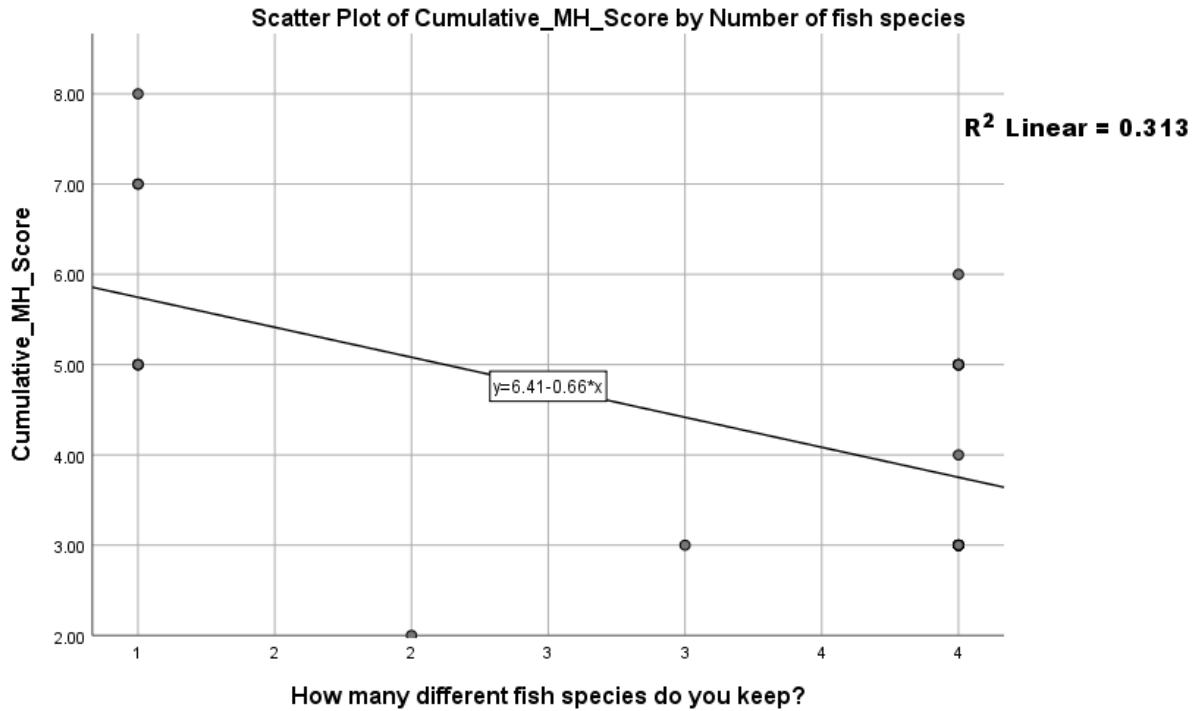


Figure 4.25: Numbers of fish species and mental health scores (Online)

Chi-Square test showed a significant association, $X^2(3, n=24) = 24.00, p = .000$, and (Missing = 1) suggesting that the number of fish species owned by participants significantly impacts their mental health scores. The Linear-by-Linear Association test did not indicate a significant linear trend, Linear-by-Linear Association = 0.748, $p = .387$. This result suggests that while there is an overall significant difference, there isn't a consistent linear relationship between the number of fish species and mental health scores. The result shows that the number of fish species owned have impact on perceived mental health status of fish keepers.

DISCUSSION

The findings in this study provide significant insights into the relationship between fishkeeping and mental health. Through an analysis of perceived stress levels, demographic data, and the impact of various factors (such as the number of fish species owned, time spent on aquarium maintenance, and other variables), key conclusions have emerged. Below is a discussion of the most notable results.

1. Mental Health and Stress Levels

The use of the Perceived Stress Scale (PSS) allowed for a detailed analysis of participants' stress levels. The results indicate that fish keepers, both in-person and online, primarily experience moderate stress levels. For in-person respondents, 51.5% reported moderate stress, while 92% of online fish keepers fell into the same category. However, there is still a notable proportion of fish keepers who experience high stress, with 39.4% of in-person fish keepers reporting high perceived stress. This reflects a diverse range of mental health outcomes within the group, which may be influenced by individual differences in their aquarium maintenance routines, emotional connection to their fish, or other external stressors.

Interestingly, non-fish keepers exhibited higher stress levels overall, with 56.3% reporting high perceived stress. This supports the notion that engaging with nature—whether through aquarium keeping or other means—can provide psychological relief and reduce stress. This finding aligns with theories such as Wilson's Biophilia Hypothesis (1984),

which posits that humans have an innate desire to connect with nature, potentially reducing stress through interactions with natural environments.

2. Impact of Aquarium Maintenance

One of the most significant findings relates to the time participants spent maintaining their aquariums. Both in-person and online fish keepers demonstrated a statistically significant association between time spent on aquarium maintenance and mental health scores. For in-person participants, the Chi-Square test ($p = .007$) and the Linear-by-Linear Association ($p = .001$) confirmed a meaningful relationship between maintenance time and stress levels. The more time participants spent maintaining their aquariums, the more their stress levels appeared to improve.

This finding could be linked to the attention restoration theory (Kaplan & Kaplan, 1989), which argues that engaging with restorative environments—such as fish tanks—can reduce mental fatigue and improve focus. Aquarium maintenance may provide a structured, calming activity that allows individuals to take a break from daily stressors, leading to better mental health outcomes.

3. Total Number of Fish kept and Total number of fish Species Owned

Contrary to expectations, the number of fish owned by in-person participants did not show a significant relationship with their mental health scores. The Chi-Square test results revealed that there is no significant difference with a p value of .186. This indicates that the total number of fish owned by participants does not significantly impact their mental

health scores. Additionally, the Linear-by-Linear Association test showed no significant linear relationship (Linear-by-Linear Association = 1.276, $p = .259$). This suggests that there is no consistent trend where changes in the number of fish correlate with changes in mental health scores. The result shows that the total number of fish kept did not have any impact on perceived mental health status of fish keepers.

Furthermore, regarding the total number of fish species owned For both in-person and online participants, Chi-Square tests revealed no significant difference, with in-person fish keepers showing a p-value of .186 and online participants a p-value of .259. This indicates that the number of fish does not have a direct impact on stress reduction or mental well-being.

However, the number of fish species owned by online participants did show a significant association with mental health scores ($p = .000$), while the same was not true for in-person respondents. This suggests that diversity in fish species may contribute to mental health improvements for some fishkeepers, possibly by providing a more enriching or stimulating environment. The role of species diversity in mental health is an area that could benefit from further research to understand the mechanisms behind this finding.

4. Choice of Closing the Aquarium

The study also explored whether participants had considered closing their aquariums, revealing that most fish keepers had not considered closing their tanks. This suggests a generally positive experience among aquarium keepers, which may contribute to their overall mental health. For those who had contemplated closing their aquarium, it could indicate that the maintenance or emotional investment required may sometimes become overwhelming, potentially leading to higher stress levels. However, this variable did not emerge as a significant factor in the study.

5. Hypothesis Testing

Several hypotheses were tested in the study:

- **Number of ponds/aquariums maintained:** No significant difference was found in mental health scores based on the number of ponds or aquariums, indicating that ownership alone does not play a major role in influencing stress levels.
- **Time spent on aquarium maintenance:** The hypothesis that time spent on maintenance would significantly affect mental health was supported, with significant differences found. This highlights the importance of engagement and routine in managing stress through fishkeeping.
- **Number of fish species:** There was a significant relationship between the number of fish species owned and mental health for online participants but not for in-person respondents. The variation between these two groups may reflect differences in how they interact with their aquariums or the social or psychological support they receive through online communities.

- **Total number of fish kept:** While this test was conducted for only in-person participants, there was no significant relationship between mental health and the total number of fish kept.

6. Limitations and Future Research

While the study provides valuable insights, several limitations must be noted. The sample size, particularly for online participants, was relatively small, which may limit the generalizability of the findings. Additionally, the cross-sectional design of the study means that changes in mental health over time could not be assessed.

The research was impacted by time constraints due to the need to obtain ethics approval from the University Research Ethics Committee (REC). This resulted in a shorter survey duration than initially planned in the research timetable.

While conducting the research at the stores, it was challenging to convince customers to participate in the survey as many claimed to be busy and in a hurry.

Future research could explore the long-term effects of fishkeeping on mental health, as well as the role of other variables such as emotional attachment to fish, type of aquarium environment, and social support from other fishkeepers. Investigating whether these factors contribute to stress relief could provide a more comprehensive understanding of the relationship between aquarium keeping and mental health.

Conclusion

In summary, this study highlights the potential benefits of fishkeeping for mental health, particularly through the time spent on aquarium maintenance and the diversity of fish species owned. While ownership alone does not appear to significantly impact stress levels, engaging with the aquarium environment through regular maintenance offers a significant mental health boost. These findings suggest that fishkeeping can be a valuable therapeutic tool for stress management, contributing to overall well-being.