

# HEARTS Matters: The Moderation and Mediation Effects of Resilience, Experience of Abuse, and Technology Use in Older Persons

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## Research Article

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## Abstract

**Background:** The purpose of the study was to explore the HEARTS (Health, Experience of Abuse, Resilience, Technology, and Safety) in a community sample of older adults (60 years and above) in the Philippines – one of the top ten countries in Asia with the fastest growth rate of the older adult population.

**Methods:** A cross-sectional study design was utilized in collecting data using standardized questionnaires such as PROMIS, CD-RISC, EASI. The study was able to engaged a total of 161 older adults who voluntarily joined the study.

**Results:** Findings show that among the different health indicators (i.e., physical function, anxiety, depression, fatigue, sleep disturbance, ability to participate in roles and activities, pain interference, and pain intensity), only sleep disturbance was significantly correlated with the experience of abuse. Only anxiety and fatigue were significantly correlated with resilience. Resilience was found to have a significant moderating effect between the relationship of experience of abuse and two health indicators (i.e., anxiety and pain interference). Technology use was significantly correlated with the ability to participate in social activities, pain intensity, and resilience. Our results also show that technology use had a significant mediating effect between resilience and anxiety (a health indicator).

**Conclusion:** The results provide preliminary evidence on the protective effect of resilience on the experience of abuse and selected health outcomes among older adults in the Philippines.

Resilience in older adults varies across demographic factors, and suspicions of elderly abuse exist in the community. Technology-use among older adults should be included in the framework in addressing older persons' welfare as it serves to provide communication means or entertainment purposes. Studying the health outcomes, resilience, abuse, and technology use among older adults provides a framework on how older adults should be treated and how intervention programs should be addressed.

## Background

Older adults around the world have this common plea to “add health to our years” [1]. Investing in adding health to years has significant benefits to all populations. However, the current public-health frameworks to an aging global population have been ineffective – the health of older people is not keeping up with increasing longevity, as shown in marked health status inequities of older adults within countries and around the world [2,3]. Adding extra years to health has major implications for children, youth, adults, and older persons, and it offers great opportunities and possibilities that impact how people live, love, work, play, and relate to one another. These opportunities and possibilities are solely dependent on one characteristic alone: people’s health. Therefore, to experience these extra years of productivity, there is a need to be in good health. The ability to do the things people value and desire will have few limits if they are healthy. Investment in and return on investment in adding health to years in aging should be the goal of every person, family, community, society, and country.

A valuable population group in the society that requires attention to health are the older persons or senior citizens aged 60 years old and above. The world's population is aging. Globally, the population aged 60 and over is growing faster than all younger age groups [4]. Additionally, the Philippines is considered one of the top ten countries in Asia with the fastest growth rate of older adults (60 years and above) [87]. More particularly, Central Visayas, the Philippines' central region, is one of the regions in the country that has the highest population growth rate (i.e., 8.8% increase from 2010 to 2015) [5]. Additionally, the older adult population growth rate in the Central Visayas region has increased from 7.8% in 2010 to 8.2% in 2015 [6]. The increased number of beneficiaries of the region's Social Pension for Indigent Senior Citizens program (i.e., a sixfold increase from 2011 to 2015 and fourfold from 2015 to 2018) [7,8] confirms the increasing older adult population growth rate of the Central Visayas region of the Philippines. Based on the increasing trend of the elderly, the Regional Development Council of Central Visayas chose to be pro-active in reducing the vulnerability of the older adults through the collaboration with government agencies in strengthening social development policies and developing learning resource centers that would specialize in preserving and sustaining the culture of health care for the older adult population [9].

### Overall Health of Older Adults

Older persons globally contribute to society in diverse ways – through their family, community, and society as a whole. The extent of their contributions to society largely depends on their health. Adding health to years is a goal all living persons at any age could aim for (WHO, 2015). One major challenge in assessing older persons' health is the sheer diversity of health and functional states they experience that are loosely associated with chronological age (WHO, 2015). Diversity, inequity, marginalization, and stereotyping must be addressed to transform a comprehensive global public health response to an active aging world population. Therefore, it is crucial to transform misaligned health systems that serve older adults by clearly and convincingly redefining health and by integrating the conceptualization of “adding health to years” as part of the health systems' strategic framework [10,11].

As part of a person's physiological development, an individual's physical and psychological functioning is expected to decline as one ages [12]. Knowing that these changes will occur in older persons, there is a need to monitor and anticipate modifications in older persons' lifestyle to address their need for safety [13]. Health is focused on symptom-related and function-related patient-reported outcomes [14]. Hence, we focused on the symptom-related reports (i.e., anxiety, depression, fatigue, sleep disturbance, pain interference, and pain intensity) and the function-related reports (i.e., physical function and the ability to participate in roles and activities) in the current study.

### **Experience of Abuse of Older Adults**

On the profile for elder abuse, the WHO [15] reported that elder abuse is now recognized internationally as a public health problem, urgently requiring the attention of health care systems, social welfare agencies, policymakers, researchers, educators, and the general public. With a global increase in the elderly population, elder abuse is expected to become an even more pressing problem, affecting millions worldwide. For many older persons, elder abuse is cause for concern, albeit their voices are drowned by poverty, disability, and cultural stereotypes. It is challenging to quantify the extent of elder abuse, neglect, and exploitation because many such cases go undetected and unreported [16].

Many studies on elder abuse in Asia, especially in China, India, Singapore, Japan, Korea, and South Asia, consider the subject matter taboo, something that should not be discussed outside the confines of the family [17]; these are culturally constructed barriers to prevention, recognition, and response to elder abuse, in its many forms. It is important to assess the relevance of current tools and resources that older adults, their family members, and front-line caregivers use to resolve this critical issue. In a study of 355 Hong Kong seniors (aged 65 and over), 21 percent of study participants were found to have experienced at least one instance of abuse (predominantly verbal abuse) within the past year [18]. Researchers suspected that the Chinese tradition of preserving the privacy of the family might have contributed to an underestimation and underreporting of elder abuse [18].

According to the Coalition of Services of the Elderly [19] elder abuse in the Philippines remains invisible, underestimated, unreported, and unaddressed. Elder abuse occurs in different settings, yet nothing is being done to stop it and protect the rights of older people [19]. Most cases of elder abuse occur at home, and family members are reported as the main perpetrators. Even older people who witness elder abuse remain silent and uninvolved. The COSE [19] suggests that elder abuse in the Philippines is an "invisible" problem.

### **Resilience of Older Adults**

Resilience is the ability to bounce back from adversity or circumstances that produce a significant decrease in one's quality of life [20]. As a personality trait, resilience has been defined as a stable quality that allows them to bounce back from adversity and adapt [21,22]. In this capacity, resilience is thought to moderate the effects of stress and act as a protective strength in the face of adversity [23,24,25]. Few studies have been conducted on the resilience of older adults residing in the Philippines. Most studies on the resilience of Filipino older adults have focused on the context of post-disaster coping [26,27]. In a study of older adults residing in an urban community in the northern region of the Philippines, Cuevas et al. [28] found that continuous employment in old age had a predictive effect in improving resilience despite the experience of abuse. These findings also concur with Kwan's [29] study that social support through livelihood promotes Filipino older adults' resilience despite adversities after a natural disaster.

### **Technology Use of Older Adults**

Technology such as mobile phones in older persons is slowly expanding its use. Mobile phones are the means of communication of older persons with families and social networks and a link for calls for assistance if they need help. Studies show increasing acceptability of the use of technology for health purposes [30,31] and motivation to use mobile phones to improve their mental health [32]. Berkowsky et al. [33] postulate that using technology such as mobile phones among older adults can enhance resilience. Despite preliminary evidence on the increasing acceptability of technology use among older adults, there is a dearth of studies focusing on technology use and its impact on Filipino older adults' health and resilience.

### **Health, Abuse, and Resilience of Older Adults**

Few studies were conducted on the overall health of Filipino older adults focusing on the experience of abuse, their overall health, and resilience (Cuevas et al. 2020; Flores, 2019). Flores (2019) reported that Filipino older persons exposed to abuse were more likely to have low levels of perception of overall health. Cuevas et al. (2020) found a negative relationship between resilience and experience of abuse, even though resilience showed a probability of exposure to abuse (Cuevas et al. 2020). However, the above-mentioned studies were conducted in the Luzon areas (northern areas) of the Philippines. None of these studies was undertaken in the Philippines' Visayas region (central area). Additionally, Cuevas et al. [34] and Flores [35] focused on the direct relationships of experience of abuse, overall health, and resilience with selected demographic variables. These studies did not consider the direct and indirect effects of these variables. Additionally, the use of technology and its relationship with significant factors on older adults' health were not explored.

Constantino et al. [36] also explored the relationships between overall health, the experience of abuse, and resilience among older persons residing in the Pittsburgh, Pennsylvania area. They found that the positive health features such as physical function and social roles increased with education. In contrast, negative health features (anxiety, depression, fatigue, sleep disturbance, pain interference, and pain intensity) decreased as education increased [36]. The same study showed that resilience predicts anxiety and depression [36]. Although Constantino et al.'s [36] study provides preliminary evidence on the relationships between health, resilience, and abuse, they did not report findings on the indirect effects of health, resilience, and abuse on technology use of older adults. Additionally, the population of focus in the study was older adults of different racial groups residing in the United States [36].

Based on the gaps in the literature, a study on the Health, Experience of Abuse, Resilience, Technology use, and Safety (HEARTS) of older adults is imperative at redefining the health of older persons more broadly and diversely, including physical function, anxiety, depression, fatigue, sleep disturbance and sleep-related impairments, the ability to participate in social roles and activities, pain interference, and pain intensity. Consequently, it is also imperative to explore the health, the experience of abuse, resilience, technology use, and safety of older persons and their correlations by testing on the moderating and mediating effects of the experience of abuse and resilience on health and technology use. Therefore, we developed three hypothetical models (Figures 1 to 3) to test specific relationships among the variables.

More particularly, we hypothesize that the experience of abuse has a direct effect on health (i.e., physical function, anxiety, depression, fatigue, sleep disturbance, ability to participate in roles and activities, pain interference, and pain intensity) and that resilience moderates the effect of abuse on the health outcomes of older adults (Figure 1). This first hypothetical model (Figure 1) is theoretically supported by studies indicating that older persons who are at risk of abuse are predisposed to behavioral, social, and environmental risk factors that exacerbate pain, anxiety, depression, deterioration of physical health, and sleep [37,38,39]. Additionally, Cuevas et al. [40] had established that abuse has a negative correlation with the health of Filipino older adults and a negative correlation between resilience and experience of abuse.

We also hypothesize that particular health outcomes, namely the physical function, anxiety, depression, fatigue, ability to participate in roles and activities, pain interference, and pain intensity, have a direct effect on sleep disturbance, and that the experience of abuse mediates between overall health and sleep disturbance (Figure 2). We highlight sleep disturbances and sleep-related impairments among other determinants of health through our second hypothetical model (Figure 2) because sleep is a restorative process. More importantly, sleep acts as the brain's housekeeper that initiates metabolic clearance by enhancing the removal of potential interstitial neurotoxic waste to restore metabolic homeostasis [41,42]. In older persons, however, sleep is a diminishing commodity. The consequences of sleep disturbances and sleep-related impairments can be health- and life-threatening [43,44,45]. Sleep disturbances and sleep-related impairments are significant public health problems among older adults (60 years and older). Rates of sleep disturbances and sleep-related impairments exceed 20% to 30% in this age group, making it more frequent than for any other age group [41]. Despite this information, there is much to be done in enhancing our understanding of sleep in older persons. Sleep disturbance and sleep-related impairments are among the most common disorders in aging, but they are overlooked as symptoms of other disorders [41]. Hence, our second hypothetical model (Figure 2) is theoretically supported by study findings showing that abuse in older persons affects sleep quality in later life [46], and that health indicators such as physical activity and depression also predispose sleep disturbance in older persons [47].

Finally, we hypothesize that resilience has a direct effect on health outcomes of older adults and that technology use mediates the effect of resilience on health (Figure 3). The third hypothetical model (Figure 3) is theoretically supported by how the use of technology facilitates in monitoring health (e.g., remote monitoring), providing health information to help with decision making, and enhancing social support [48,49]. Additionally, a strategy in which technology can enhance older adults' health is by promoting resilience [33]. Although there is evidence on the positive effect of technology use on the resilience of older adults [33, 50] and on health outcomes [49] the mediating effect of technology use on the relationship between resilience and health remains underexplored.

## **Aims of the Study**

The following are the aims of the study: (1) To assess the HEARTS (Health, Experience of Abuse, Resilience, Technology use [mobile/phone] and Safety) of older adults; (2) To determine the relationships between health indicators (i.e., sleep disturbance and sleep-related impairments, resilience, and experience of abuse); and (3) To assess the difference between technology-use based on health indicators and resilience among older adults. Therefore, we hypothesize the following:

**Hypothesis 1.** Better health indicators are significantly correlated with the resilience of older adults.

**Hypothesis 2.** Health indicators are expected to be reduced among older adults who have experienced abuse.

**Hypothesis 3.** Resilience will moderate the relationship between the experience of abuse and health.

**Hypothesis 4.** Experience of abuse will mediate between overall health and sleep disturbance and sleep-related impairments.

**Hypothesis 5.** Technology users (mobile phones) have better overall health and resilience than those who are not technology users.

**Hypothesis 6:** Technology use mediates the effects of resilience on health.

## Methods

### *Design and Setting*

A cross-sectional, correlational study was utilized. Additionally, a community-engaged research approach was used in which research participants were also stakeholders of the research project. Through community-based participatory research engagement, we collaborated and formed partnerships with individuals, *barangays* (i.e., district or ward of a town/city), advocacy groups, and providers of services to conduct the current research with a long-term goal of developing effective and relevant older adult-centered interventions. As a result, we were able to recruit community-based research assistants who were primarily responsible for the data collection.

### *Participants*

A total of 161 participants were recruited using purposive sampling. Inclusion criteria were as follows: age 60 years old or older and being a resident in one of the four identified *barangays* in Cebu City, Philippines (a central region of the country). Older persons with co-morbid conditions resulting in memory loss and/or cognitive impairment were excluded from the study. Likewise, older persons who were unwilling to be interviewed or participate in the research were excluded from the study. With an  $\alpha$  of .05 and power of about .80, approximately 161 subjects were required to detect a population correlation of 0.14

### **Procedures**

Ethics approval to conduct the study was obtained from the university's ethics review committee (ERC 344/2019-07). Participants were recruited through word of mouth and snowball sampling. Older adults who volunteered to participate were invited to attend a group orientation to the study. Data gathering was conducted from August to September 2019. Informed consent was obtained before completing the paper-and-pencil questionnaires, which comprised of a socio-demographic data questionnaire and survey measures assessing HEARTS (Health, Experience of Abuse, Resilience, Technology use [mobile/phone] and Safety). Participants completed the surveys at an average of 30-45 minutes in a quiet, comfortable place with *barangay*-based volunteers' assistance. All collected data were anonymized for confidentiality considerations.

### **Measures**

The questionnaires used in the study were instruments previously developed and published. The discussion on the measurement of variables present the instruments and their corresponding sources.

**Health.** Health indicators (i.e., physical function, anxiety, depression, fatigue, sleep disturbance, and sleep-related impairment, ability to participate in social roles and activities, pain interference, and pain intensity) were measured through the PROMIS29 v2.0 (Patient-Reported Outcomes Measurement Information System) [86]. The PROMIS was developed by the National Institute of Health (NIH) based on item response theory to reduce participant burden in completing multiple surveys on physical, mental, and social domains of health while not compromising reliability and precision [14]. Each health indicator was rated using a 5-point Likert scale, with higher scores indicating higher levels of anxiety, depression, fatigue, sleep disturbance, pain interference, and pain intensity as well as poorer social health (i.e., perception of well-being with social activities and ability to relate to others [14]. The PROMIS demonstrates good reliability, precision, and construct validity [14].

**Experience of abuse.** The Elder Abuse Suspicion Index (EASI) [51] was used to assess the presence of different types of elder abuse such as financial/material, neglect/abandonment, physical, psychological/emotional, and sexual types of abuse [51]. Scores were obtained by summing up the number of "yes" responses. A score of 0 means no elder abuse suspicions, while 5 means high suspicion of elder abuse. The EASI has a sensitivity of 0.47 and specificity of 0.75 for elder abuse ([51].

**Resilience.** The Connor-Davidson Resilience Scale (CD-RISC, Connor and Davidson, 2003) was used to measure resilience. The CD-RISC consists of 25 items, with higher total scores indicating a higher level of resilience. The CD-RISC was reported to have a good internal consistency ( $\alpha = 0.89$ ) and test-retest reliability (intraclass correlation coefficient of 0.87) [52].

**Technology use and safety.** Participants were asked to respond to two yes/no questions indicating their use of mobile phones and whether they felt safe or not in their respective communities (*barangays*).

### **Data Analysis**

SPSS (v. 21; IBM SPSS, Armonk, NY) was used for all data analyses. Descriptive statistics were calculated for all relevant measures. Pearson's *r* correlations, bivariate and multiple regression analyses, and t-tests were also used to evaluate potential correlations among variables and test for significant differences in scores. The PROCESS (v. 3) macro of Hayes [53] was used to develop mediation and moderation models.

## Results

### Participants

The mean age was 70.22, and the majority of the respondents were female, widowed, and had been married for an average of 28 years when their spouses were still alive. Most of them attended school at the basic education level (elementary school), were full-time homemakers without a current job. Most participants had no mobile phones. Table 1 provides further detail on the demographic background of the participants.

Table 2 shows the H.E.A.R./T.S. (Health, Experience of Abuse, Resilience, Technology use [mobile/phone] and Safety) profile of older adults. The health profile of the sample generally showed low levels of anxiety and depression. The average fatigue, pain interference, and pain intensity were slightly below the median. Sleep disturbance was above the median, and the incidence of abuse among older adults was low while the resilience level was high. Data further show that most of the participants have no opportunities to use technology gadgets like mobile phones. The use of these gadgets requires expenses, and the participants' economic profile generally showed very low income. Additionally, mobile phones and their features are still intimidating to some older persons [70, 88]. About 88% of the participants felt safe in the places where they are residing.

Table 3 shows correlations between health indicators (i.e., physical function, anxiety, depression, fatigue, sleep, ability to participate in social roles and activities, pain interference, and pain intensity), the experience of abuse, and resilience. Based on the hypothesis 1, only anxiety ( $r = -0.206$ ;  $p = 0.01$ ) and fatigue ( $r = -0.173$ ;  $p = 0.05$ ) are significantly correlated with resilience. Concerning hypothesis 2, only sleep disturbance was significantly correlated to the experience of abuse ( $r = -0.174$ ;  $p = 0.05$ ). It is critical to note that based on the descriptive data, respondents have a very low incidence of abuse while sleep disturbances were frequently reported. Hence, bivariate regression analysis between the experience of abuse and sleep disturbance was conducted. Bivariate regression analysis showed that the incidence of abuse among older adults significantly predicted sleep disturbance ( $p = 0.027$ ). Further exploration was conducted to include the other health indicators with slightly high means (i.e., anxiety, fatigue, and pain intensity) into the regression equation; as a result, these additional variables did not come out as predictors of sleep disturbance.

Table 4 shows the moderation effect of resilience between abuse and health. Based on hypothesis 3, the moderation model demonstrates that resilience has a significant moderation effect between abuse and anxiety ( $b = -.07$ ;  $se = .03$ ;  $t = -2.52$ ;  $p = .01$ ) and between abuse and pain interference ( $b = -.07$ ;  $se = .04$ ;  $t = -2.01$ ;  $p = .05$ ). Figures 4 and 5 further show the direction of the interaction effect of resilience. On the effect of abuse on anxiety and pain interference, higher resilience tends to reduce the effect of abuse on anxiety and pain interference, and the opposite effect is indicated for lower resilience.

To respond to hypothesis 4, we determined the direct effect of health outcomes and abuse on the variable sleep disturbance and sleep-related impairment (see Table 5). As shown in Table 5, none of the changes in health predictors have a direct significant effect to sleep disturbance. However, the experience of abuse has shown a significant direct effect ( $b = -.62$ ;  $p = .03$ ) to sleep disturbance. We also determined the indirect effects of health indicators to experience abuse; our analysis has shown no significant indirect effects. Based on these findings, therefore, the experience of abuse has not shown a mediating effect on health and sleep disturbance but has a direct effect on sleep disturbance. Experience of abuse accounts for 17% ( $R^2 = .174$ ) of the changes in sleep among the respondents (see Table 5).

Based on hypothesis 5, Table 6 shows that respondents who use mobile phones have better social health (ability to participate in social roles and activities,  $t = -2.42$ ;  $p = 0.02$ ), lesser pain intensity ( $t = 2.35$ ;  $p = 0.02$ ), and higher resilience ( $t = -2.41$ ;  $p = 0.02$ ) than those without mobile phones. Finally, based on hypothesis 6, Table 7 show that the overall effect of resilience combined with technology-use only affects anxiety ( $F = 4.0$ ;  $p = .02$ ) among all the health indicators. Further analysis shows that when the direct effect between resilience to health was analyzed, only anxiety ( $b = .34$ ;  $p = .01$ ) and fatigue ( $b = -.05$ ;  $p = .03$ ) among the health indicators were predicted by resilience (see Table 8). Resilience was also a significant predictor of technology-use ( $b = .01$ ;  $p = 0.05$ , see Table 8) among respondents. In determining the direct effect of technology-use on health, only participation in social roles ( $b = 1.71$ ;  $p = .04$ ) and pain intensity ( $b = -1.10$ ;  $p = .03$ ) were influenced significantly (see Table 9). The findings show that resilience can have a direct effect on anxiety and is also mediated by technology-use or the use of mobile phones.

## Discussion

In this study, we examined the health (physical, mental, and social health), resilience, the experience of abuse, and use of technology of Filipino older adults in Cebu City, Philippines. We also explored the relationships between resilience, the experience of abuse, and the health indicators.

Finally, we analyzed the role of technology in resilience and health among these older adults in the Philippines.

### **Health Status, Level of Resilience, and Experience of Abuse**

Our findings on the low levels of anxiety and depression are consistent with other studies involving the prevalence of anxiety and depression of Asians [54,55,56]. The low prevalence of abuse in our sample may be attributed to our community-based sample compared to older adults in primary care and institutionalized settings with a higher prevalence of elder abuse [57,58]. Additionally, disclosure of mental health symptoms and abuse remain stigmatized within the Asian culture [18]. On the other hand, the level of resilience in our sample was high, which is consistent with other studies involving Filipino older adults [28, 26]. These findings demonstrate that Filipinos have always shown psychological resilience, which can be traced back to the Filipino philosophy in life, in which resilience of Filipinos are based on strong social support and extensive experience on enduring economic hardships [59,60].

### **Relationship Between Health, Resilience, and Experience of Abuse**

Based on our first hypothesis, we only found anxiety and fatigue among the health indicators to be significantly correlated with resilience. These findings concur with other studies on the negative correlation between resilience and mental health symptoms of depression, apathy, and anxiety among older adults (Laird et al. 2019a, 2019b). Additionally, these two health indicators (i.e., anxiety and fatigue) are focused more on internal disturbances, which can be moderated with one's ability to adjust and move back to the usual norms of living. These findings also imply that resilience has an impact on the adaptation of one person to stress in later life [61,62,63].

Regarding our second hypothesis, our findings of the sleep disturbances as being the only predictor of experience of abuse aligns with findings with other studies, suggesting the imperative of focusing on sleep disturbance and sleep-related impairments among older adults [64]. Focusing on sleep-related impairment is important because such impairments are among the most common disorders in aging, but they are overlooked as symptoms of other disorders [41]. Additionally, our findings show that sleep disturbance is a common manifestation when a person is subjected to abuse [46]. Consequently, there is a call to action to focus on sleep disturbance and sleep-related impairments among older adults at the University of Pittsburgh, School of Nursing Research Hub in Sleep and Circadian Rhythms [64].

Based on the third hypothesis, our findings show that resilience has a moderating effect on the relationship between the experience of abuse and health (i.e., anxiety and pain interference). On the other hand, we did not find any moderating effect of resilience between the experience of abuse and other health indicators. Our findings further show that higher resilience has a predictive effect in reducing the effect of abuse on anxiety and pain interference. Such findings are consistent with Coatta's [61] theoretical postulation in that resilience allows an older adult to cope, adjust, and bounced back from the negative consequences of aging with multiple chronic conditions, thereby reducing the negative effect of abuse on emotional health experiences (e.g., anxiety) and chronic physical conditions (e.g., pain).

Regarding the fourth hypothesis, our findings on the mediating effect of the experience of abuse on the overall health and sleep disturbances were consistent with the study of Yunus et al [65] in that experience of abuse affects the sleeping pattern of older persons. Based on our findings on the significant relationship between resilience and anxiety (hypothesis 1) and the mediating effect of abuse on the overall health and sleep disturbances (hypothesis 4), we surmise that the sleep disturbance could be attributed to the increased anxiety in older adults [66,67]. Elderly abuse affects the psychological status and functioning, which can lead to an inability to sleep and other sleep-related disturbances. In the study of Yunus et al. [47], poor sleep is most often related to neglect as a form of abuse. However, studies show that elderly mistreatment predicts physical and psychological health [68].

Based on our fifth hypothesis, our findings show that none of the health indicators except for pain intensity indicated a significant difference between those who used mobile phones and those who did not. This implies that those who used mobile phones have perceived the pain intensity as lesser than those without mobile phones. In the study of Andrews et al [32], older adults use technology such as mobile phones to improve their mood through mechanisms of distraction and normalization. When older persons are engaged with mobile phone use, they can resort to games and other alternative activities on their phones, which can help them lessen their focus on their everyday pains.

Finally, based on our last hypothesis, we found that resilience does not influence older adults' physical functioning. Physical functioning may decline in older adults, but one's capacity to adjust can still enhance even with old age and social functioning [69]. Our findings on resilience as a significant predictor of technology use show that resilience has a direct effect on anxiety and is constantly mediated by technology use or the use of mobile phones. The use of technology in older persons has increased its popularity as mobile phones and internet use have provided easy access [70]. The use of mobile phones among older adults has shown significant positive effect on mental health [71]. Subramanyam et al. [72] shared the findings that older persons used mobile phones due to their convenience and peace of mind that they can contact anybody at any time, especially during emergencies. Therefore, this implies that the use of mobile phones demonstrates its positive effect in reducing worries and anxiety among older persons. However, a study on excessive use of phones also revealed a negative effect on mental health depending on the user's motivations [73]. In another perspective, resilience and mobile phone use among older adults has shown a significant

effect on fatigue and pain intensity. This can be attributed to the entertainment effect of mobile phones, which provide distraction and relaxation for older persons. In contrast, mobile phone use among older persons can heighten their self-esteem when they can overcome the technical barriers of using the gadget [72]

Overall, our findings indicate that older adults' health often goes through changes as advanced age takes place. However, some factors contribute to the physical, emotional, and social health of older adults that necessitate attention. Two factors considered in the study were the effects of resilience and experiences of abuse among older persons. In this current study, we found that resilience moderates the relationship between elder abuse and aspects of health (i.e., anxiety and pain interference); that experience of abuse has a direct effect on sleep disturbances; and that technology use mediate the relationship between resilience and certain indicators of health (i.e., anxiety and fatigue). We conclude that elder abuse is a reality among older adults that have repercussions for their health and resilience (Cuevas et al. 2020). However, resilience among adults, which is not uncommon among older adults, has been shown to buffer the negative effects of aging, medical comorbidity, and mental health symptoms (i.e., depression apathy and anxiety) [74,75].

## Limitations

The present study has several limitations. First, we used convenience sampling, which limits the generalizability of the results. Therefore, our findings should be considered preliminary. Second, our sample was geographically limited to four barangay units in Cebu City, Philippines. Hence, the results of the present study should be interpreted with caution. Lastly, our findings on the low prevalence of reported abuse in our sample may have contributed to the lack of mediating effect of the experience of abuse on overall health and sleep disturbance. We surmise that Filipinos' general cultural norms in non-disclosure of mental health concerns [76] may have contributed to the low prevalence of reporting abuse in our sample. Therefore, future research processes on assessing the history of abuse among Filipino older adults must include considering the collectivistic cultural values of Filipinos, such as general Asian cultural norms maintaining family's reputation and preserving family integrity [76].

## Conclusions

Resilience in older adults varies across demographic factors, and suspicions of elderly abuse exist in the community. Technology-use among older adults should be included in the framework in addressing older persons' welfare as it serves to provide communication means or entertainment purposes. Studying the health outcomes, resilience, abuse, and technology use among older adults provides a framework on how older adults should be treated and how intervention programs should be addressed. This research project catalyzed enabling social innovations and community engagement. Our next steps are to develop evidence-based electronic health interventions for older adults such as text messaging [77, 78] and emailing [79, 80] technologies and integrating socio-behavioral [81, 80] and stress-biology/molecular genetic [82] outcomes to measure resilience. Our next steps will also include developing and testing resilience interventions for older adults that focus on clinical electronic intervention science and stress biology bullies, assaults, and intimate partner violence [83, 84, 85].

## Abbreviations

CD-RISC Connor-Davidson Resilience Scale

COSE Coalition of Services of the Elderly

EASI Elder Abuse Suspicion Index

H.E.A.R.T.S Health, Experience of Abuse, Resilience, Technology, and Safety

PSA Philippine Statistics Authority

PROMIS Patient-Reported Outcomes Measurement Information System

SPSS Statistical Packages of Social Sciences

WHO World Health Organization

## Declarations

### Ethics approval and consent to participate

Study participants signed a written informed consent prior to the data collection to signify their voluntary participation. Ethics approval to conduct the study was obtained from the Cebu Normal University Ethics Review Committee (ERC 344/2019-07).



## Consent for publication

All authors agreed to publish the paper.

## Availability of data and material

Raw data are available in the electronic data drive of the corresponding author.

Qualitative Tools were obtained from open sources such as PROMIS, CR-RISC, EASI with the consent of the authors. These tools are available online and have no licenses.

## Competing interests

Authors declare that they have no competing interests.

## Funding

The study received no monetary funding from any agency.

## Authors' contributions

DRP, REC, LRG, JTC, VH, PEGC, and RAT conceptualized and designed the study. The expansion of the study concept was also done by EN, JIG, LT, LP, JMC, VP and JC. The data collection, analysis and interpretation was conducted by majority of the authors with the main inputs from DRP, REC, LRG, JTC and ATR. DRP, REC, ATR, EN drafted the full manuscript with the inputs from all authors for review and editing. All authors have read and approved the final form of the manuscript.

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## Tables

**Table 1** Demographic Profile of the Older Adults (n=161)

Demographic Profile	Frequency	Percentage
<b>Gender</b>		
Male	32	19.9
Female	129	80.1
<b>Civil Status:</b>		
Never Married	10	6.2
Currently Married	60	37.3
Unmarried, Living with Partner	3	1.9
Widowed	84	52.2
Separated	4	2.5
<b>Highest Educational Status</b>		
Elementary	91	56.5
High School	47	29.2
Vocational/Technical	7	4.3
Four-Year College	12	7.5
Graduate School: Masters	1	0.6
Professional MD, DMD, JD	1	0.6
Graduate School: Doctorate	2	1.2
<b>Employment Status</b>		
Full Time (35 hours per week or more)	10	6.2
Par-time (less than 35 hours per week)	6	3.7
Laid Off/Unemployed still seeking work	1	0.6
Retired/ Not working at all	27	16.8
Retired but working part-time/full time	3	1.9
Full-time homemaker	79	49.1
Others	35	21.7
<b>Monthly Income</b>		
Below P10,000	116	72.05
PHP10,000–PHP49,999	32	19.88
PHP50,000–PHP99,999	9	5.59
PHP100,000 and above	4	2.48
<b>Use of Mobile Phone</b>		
Yes	42	26.09
No	119	73.91

Note: PHP = Philippine peso (the currency of the Philippines).

**Table 2** H.E.A.R.T.S. Profile

Profile	Mean (SD)	Profile	Proportion (%)
Health indicators (PROMIS)		Technology (Use of Mobile Phone)	
Symptom-oriented indicators:		Yes	
Anxiety	6.61(3.74)	No	42 (26.09)
Depression	5.57 (3.41)		119 (73.91)
Fatigue	8.45 (4.03)	Safety	
Sleep disturbance	11.47 (3.23)	Feels safe	
Pain interference	7.25 (4.41)	Do not feel safe	142 (88.2)
Pain intensity	3.60 (2.84)		19 (11.8)
Function-oriented indicators:			
Physical functioning	17.47 (3.74)		
Ability to participate in social role and activities	16.76 (4.63)		
Experience of abuse	0.90 (0.88)		
Resilience	87.88 (13.07)		

Table 3  
Correlation Matrix on Health Indicators, Abuse and Resilience

	1	2	3	4	5	6	7	8	9	10
1. Physical Function	1									
2. Anxiety	-0.156*	1								
3. Depression	-0.283**	0.437**	1							
4. Fatigue	-0.426**	0.377**	0.378**	1						
5. Sleep	0.085	-0.030	-0.088	-0.067	1					
6. Social Health	0.366**	-0.121	-0.287**	-0.233**	0.106	1				
7. Pain Interference	-0.408**	0.269**	0.468**	0.435**	-0.038	-0.288**	1			
8. Pain Intensity	-0.411**	0.332**	0.462**	0.396**	0.035	-0.352**	0.519**	1		
9. Abuse	-0.012	0.133	0.050	0.120	-0.174*	-0.063	0.021	0.039	1	
10. Resilience	0.079	-0.206**	-0.144	-0.173*	-0.009	0.046	-0.141	-0.093	0.062	1
** correlation is significant at 0.01; * correlation is significant at 0.05.										
Social health = the ability to participate in social roles and activities										

Table 4 Moderation Effect of Resilience Between Abuse and Health

	$\beta$	sd	t	p
Outcome: Physical Functioning				
Constant	16.67	2.77	6.02	.00
Abuse	-1.83	2.91	-.63	.53
Resilience	.01	.03	-.34	.73
Abuse: Abuse x Resilience	.02	.03	.61	.54
Outcome: Anxiety				
Constant	6.89	2.4	2.87	.00
Abuse	6.91	2.53	2.73	.01
Resilience:	-.01	.03	-.40	.69
Abuse: Abuse x Resilience	-.07	.03	-2.52	<b>.01</b>
Outcome: Depression				
Constant	6.64	2.18	3.05	.00
Abuse	2.83	2.29	1.23	.22
Resilience:	-.01	.02	-.62	.54
Abuse: Abuse x Resilience	-.03	.03	-1.15	.25
Outcome: Fatigue				
Constant	13.61	2.93	4.65	.00
Abuse	-.63	3.08	-.20	.84
Resilience:	-.06	.03	-1.98	.05
Abuse: Abuse x Resilience	.01	.03	.40	.69
Outcome: Sleep Disturbance				
Constant	10.77	2.37	4.55	.00
Abuse	1.25	2.49	.50	.62
Resilience:	.01	.03	.53	.59
Abuse: Abuse x Resilience	-.02	.03	-.76	.45
Outcome: Participation in Social				
Constant	16.31	3.43	4.75	.00
Abuse	-1.58	3.61	-.44	.66
Resilience:	.01	.04	.24	.81
Abuse: Abuse x Resilience	.01	.04	.34	.73
Outcome: Pain Interference				
Constant	6.96	3.21	2.17	.03
Abuse	6.89	3.38	2.04	.04
Resilience:	.00	.04	.00	1.0
Abuse: Abuse x Resilience	-.07	.04	-2.01	<b>.05</b>
Outcome: Pain Intensity				
Constant	3.81	2.10	1.82	.07
Abuse	2.44	2.21	1.10	.27
Resilience:	.00	.02	-.19	.85
Abuse: Abuse x Resilience	-.03	.02	-1.04	.30



Table 5  
The Direct Effect among Health Indicators, Abuse and Sleep Disturbance

Predictors	Beta	p-value	R <sup>2</sup>
Physical Functioning	.07	.42	NA
Anxiety	.02	.18	
Depression	-.11	.31	
Fatigue	-.02	.84	
Participation in Social Roles and Activities	.06	.31	
Pain Interference	-.01	.95	
Pain Intensity	.18	.12	
Experience of Abuse	-.62	.03	.174
Outcome: Sleep Disturbance			

Table 6  
Health and Resilience among Technology Users and Non-Technology Users

	Mean		Standard Deviation		t	p-value
	No Gadget	With Gadget	No Gadget	With Gadget		
Physical Functioning	17.25	18.10	3.87	3.28	-1.37	0.18
Anxiety	6.52	6.86	3.53	3.06	-.59	0.56
Depression	5.77	4.98	3.20	2.15	1.80	0.08
Fatigue	8.64	7.90	4.03	4.02	1.02	0.31
Sleep Disturbance	11.29	12.02	3.02	3.76	-1.11	0.27
Social Health	16.31	18.02	4.89	3.54	-2.42	0.02*
Pain Interference	7.50	6.55	4.55	3.98	1.28	0.21
Pain Intensity	3.88	2.79	2.92	2.47	2.35	0.02*
Resilience	86.69	91.24	14.09	8.91	-2.41	0.02*
* significant at 0.05. Social health = the ability to participate in social roles and activities						

Table 7  
The Overall Effect of Resilience and Technology-Use on Health

Health Outcomes	F	p-value
Physical Functioning	1.129	.33
Anxiety	4.00	.02
Depression	2.46	-.08
Fatigue	2.68	.07
Participation in Social Roles and Activities	.80	.45
Pain Interference	2.05	.13
Pain Intensity	2.73	.06
Predictors = resilience; technology use. Outcome = health		

Table 8  
The Direct Effect Between Resilience to Health and Technology Use

Health Outcomes	Beta	p-value
Physical Functioning	.02	.32
Anxiety	-.05	.01
Depression	-.03	.07
Fatigue	-.05	.03
Participation in Social Roles and Activities	-.02	.91
Pain Interference	-.05	.08
Pain Intensity	-.02	.24
Technology Use	.01	.05
Predictors = resilience; Outcome = health and technology use		

Table 9  
Effect of Technology Use on Health

Health Outcomes	Beta	p-value
Physical Functioning	.84	.21
Anxiety	.34	.58
Depression	-.80	.14
Fatigue	-.73	.31
Sleep Disturbance	.71	.22
Participation in Social Roles and Activities	1.71	.04
Pain Interference	-.95	.23
Pain Intensity	-1.10	.03
Predictor = technology use; Outcome = health outcomes		

## Figures

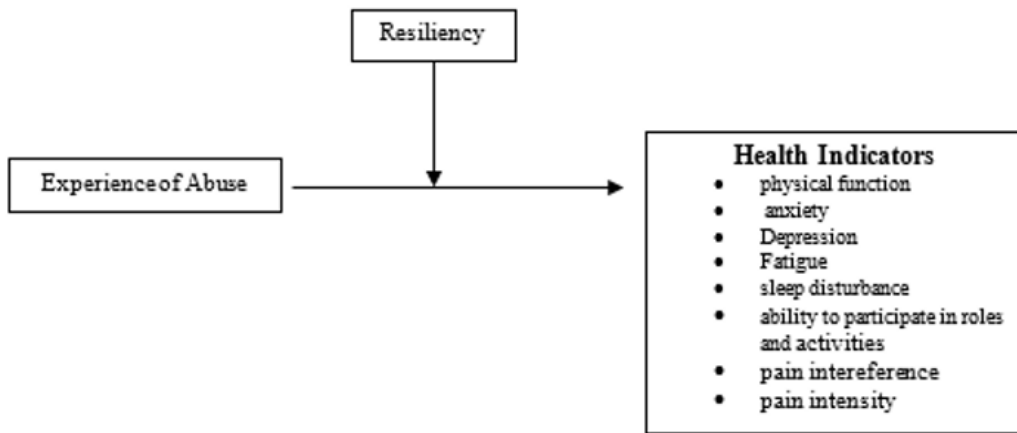


Figure 1

The moderating effect of resilience between experience of abuse and health

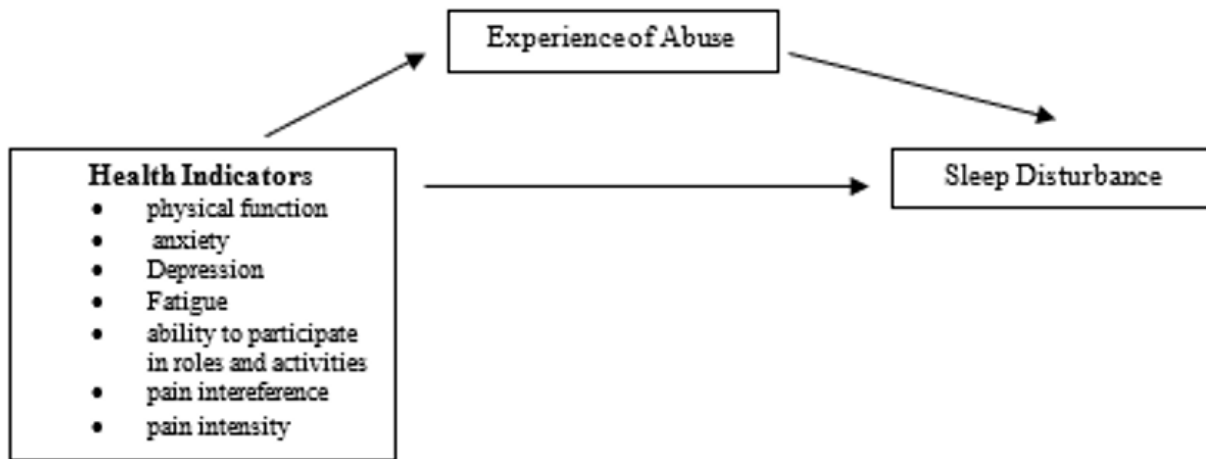


Figure 2

The mediating effect of experience of abuse between health and sleep disturbance

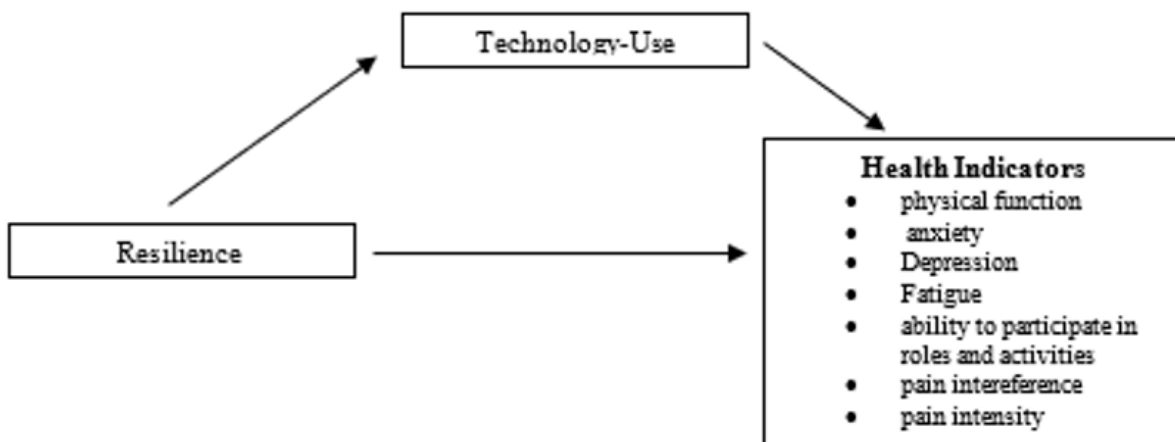


Figure 3

The mediating effect of technology-use between resilience and health

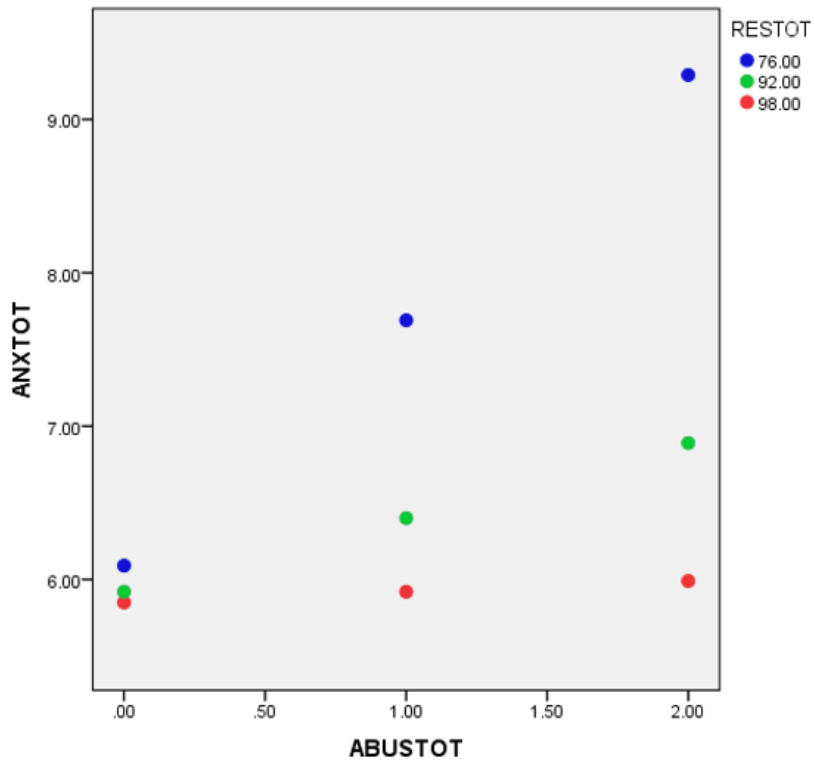


Figure 4

Interaction effect of abuse, anxiety, and resilience

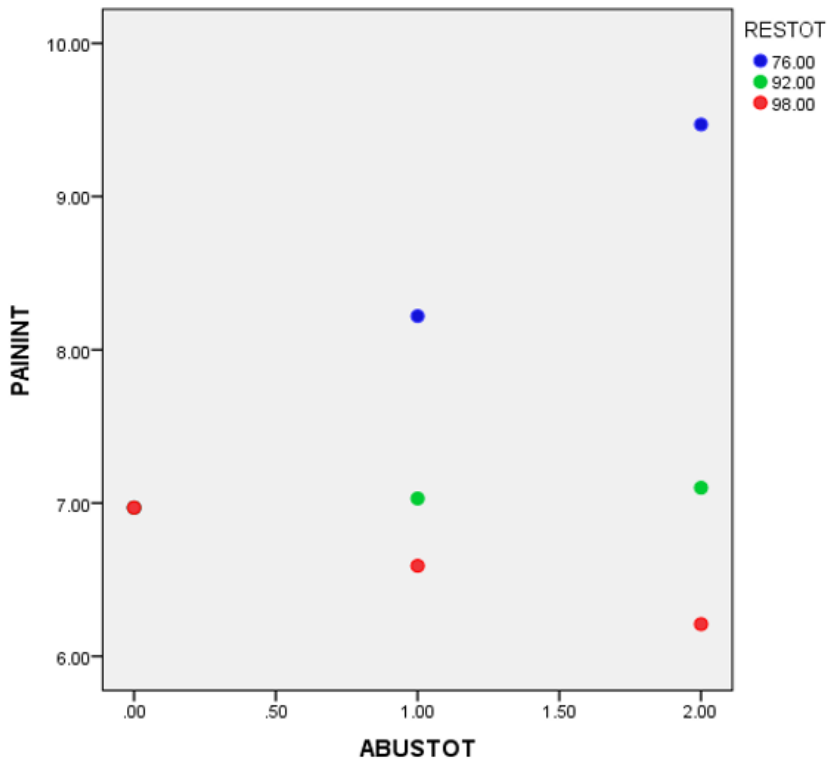


Figure 5

Interaction effect of abuse, pain interference, and resilience