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A Comparative Assessment on the Cytotoxicity of *Kappaphycus alvarezii* and *Kappaphycus striatus* Seaweeds using Brine Shrimp Lethality Assay

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ABSTRACT

Seaweed farming plays a crucial role in the Philippine economy, particularly in the Caraga region, where the cultivation of *Kappaphycus* spp. is highly prevalent and abundant. This study provided a preliminary assessment on its toxicology with a comprehensive comparison between *K. alvarezii* and *K. striatus* collected from Barobo, Surigao del Sur. Brine shrimp lethality assay (BSLA) was employed to assess the cytotoxic activity of both species. Results revealed that both methanolic crude extracts of two species exhibited bioactivity (% mortality) towards the test samples with highly significant Spearman's rho correlation among all concentrations ($p<0.001$). Comparison of extracts per concentration also revealed that *K. alvarezii* significantly exhibited higher mortality over *K. striatus* at concentrations of 1000 µg/mL ($p<0.001$) and 10 µg/mL ($p<0.01$). Median Lethal Concentration (LC_{50}) values showed that *K. alvarezii* (38.9 ppm) had higher lethality compared to *K. striatus* (2187.76 ppm) with a highly significant statistical difference value of 45.54 ($p<0.0001$). This study showed potential pharmaceutical implications for both species of *Kappaphycus*. Moreover, the significantly higher lethality of *K. alvarezii* indicates it as a more promising species for further studies on bioactivity potential and medicinal research. Studies on these fields would mean an additional potential market for the thriving seaweed industry in Caraga, Philippines.

Keywords: *Seaweeds, Kappaphycus, Median Lethal Concentration, Cytotoxicity, Brine Shrimp Lethality Assay*

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1 Introduction

The cultivation of *Kappaphycus* spp. in marine coastal environments has resulted in substantial socioeconomic benefits for communities, especially those in coastal areas. Additionally, local coastal households' economic reliance on seaweed farming is growing, making farmers crucial partners in the prudent management of coastal and marine resources (Samonte 2017). Through this, seaweed farming is regarded as a significant direct-use value for coastal and marine ecosystems that contributes to positive net present values, along with tourism and fishing (Mateo et al. 2021).

For the Caraga Region in the Philippines, its aquaculture subsector contributes mainly to the fisheries production in the country, with a total production value reaching Php 1.14 billion in 2019 and a 16.30% share of the total fisheries value of production. Specifically in

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its seaweed industry, Caraga has produced 8,468.17 metric tons of seaweeds belonging to the genus *Kappaphycus*, and the majority of it came from the province of Surigao del Sur, accounting for 8,367.62 metric tons (Philippine Statistics Authority 2020). Consequently, the consumption of seaweeds, especially *Kappaphycus* spp., is known to be a healthy source of high fibers and minerals with low calorie content.

Seaweeds generally provide significant amounts of protein, vitamins, trace elements, and a wide range of secondary metabolites not identified in other organisms (Ferraces-Casais et al. 2012, Senthil et al. 2011). Some species of edible seaweed contain significant amounts of vitamins, proteins, fibers, carbohydrates, macronutrients (N, P, K, Ca, Mg, and S), and micronutrients (Zn, Cu, and Mn), are low in fat (about 5%) and calorific value (i.e. 827.6 kcal kg^{-1} dry alga), and also possess important biological compounds (e.g. terpenoids, alkaloids, photosynthetic pigments, and polyamines) that are known to help combat disease (Gullón et al. 2021, Oucif et al. 2020, Pati et al. 2016, Rengasamy et al. 2020, Smith et al. 2010).

The Philippines' seaweed sector is likewise threatened by several interconnected hazards. Farmers are mostly confronted with environmental dangers (such as disease and pest infestations), which, if not controlled well, might lead to the failure of seaweed production. The fluctuation of the seaweed supply and the poor quality of the raw materials are viewed by dealers and processors as predecessors to other problems, such as greater competition among regional traders and processors (Suyo et al. 2021).

To highlight, one of the environmental-related risks that can cause potential issues on health are the heavy metals and metalloids (cadmium accumulation) from anthropogenic activities, including mining, milling, petrochemicals processing, printing, the electronics industry, and municipal waste, be it directly discharged into the marine environment or transported into the greater aquatic system via estuaries (Filippini et al. 2021, Wang et al. 2013). Accordingly, once toxic metals are introduced into the aquatic systems where seaweeds are cultivated or grow naturally, they easily accumulate in the multicellular marine macroalgae. With this, it is important to recognize that metal accumulation in seaweed is influenced not only by anthropogenic sources but also by various natural factors impacting the marine ecosystem, including volcanic activity and tsunamis (Jarvis & Bielmyer-Fraser 2015, Malain et al. 2012, Santawamaitre et al. 2011).

Given the significant economic value and vulnerability of *Kappaphycus* species to anthropogenic pressures, this study sought to enhance their commercial potential by evaluating their medical applications. Specifically, it aimed to conduct a preliminary cytotoxicity assessment of *Kappaphycus alvarezii* and *Kappaphycus striatus* harvested from Barobo, Surigao del Sur. Furthermore, the research compared the median lethal concentrations (LC_{50}) and overall mortality rates of both species to identify potential pharmaceutical advantages.

2 Materials and Methods

2.1 Sampling Area

The study was conducted in the coastal waters of Barobo, Surigao del Sur. Three sampling stations were set up within the study area (Figure 1). Station 1, located at 8.56389° latitude and 126.12972° longitude, cultivated *Kappaphycus alvarezii.* Stations 2 and 3, located at 8.56389° latitude, 126.13583° longitude, and 8.56389° latitude, 126.13611° longitude, respectively, cultivated *Kappaphycus* striatus. Barobo Lianga Bay is a vital coastal zone in the Caraga region, contributing significantly to the country's fisheries sector (Rasonable et al. 2023). This highlights the bay's importance as a key source of livelihood and economic activity for the local communities involved in milkfish farming.

Samples shown in Fig. 2 were harvested, placed in ziploc bags, and refrigerated under 4 °C for proper storage.

2.2 Preparation of Samples for Methanolic Extraction

The crude extraction process for *K. alvarezii* and *K. striatus* was carried out following the method outlined by Guevara (2005). The procedure was performed and closely supervised by the Regional Standards and Testing Laboratory of the Department of Science and Technology in Caraga. Stored seaweed samples were washed 3 times with distilled water. The samples were then air-dried for 86 hours and then freeze-dried for 14 hours to achieve the texture ideal for pulverization.

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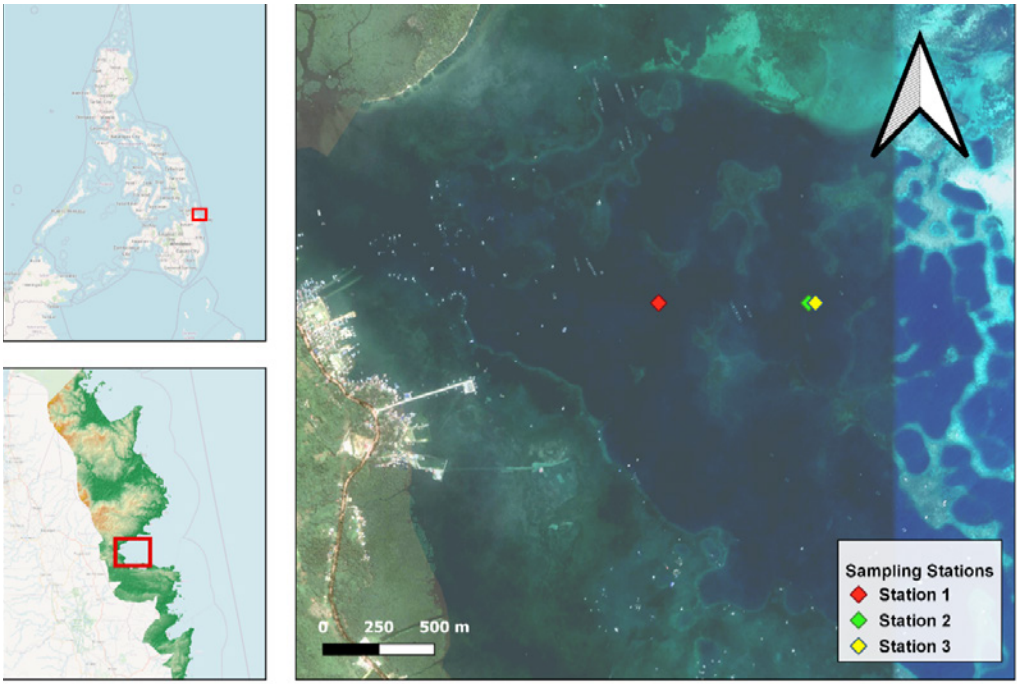

Figure 1. Sampling stations within the coastal waters of Barobo, Surigao del Sur. Aerial view of all sampling sites of *Kappaphycus* spp. farms and the established permanent sites using QGIS version 3.18.2.

Figure 2. Actual samples of *K. alvarezii* (A) and *K. striatus* (B) harvested from Barobo, Surigao del Sur.

Pulverized 250 grams of *K. alvarezii* and 183 grams of K. striatus were soaked separately in Erlenmeyer flasks with 160 ml 95% methanol solution. The flasks were covered with rubber stoppers, and the samples were soaked for 48 hours. After the soaking process, the samples were filtered through a Buchner funnel with gentle suction. The flask and seaweed material were rinsed with fresh portions of methanol. The washings and seaweed material were transferred to the funnel, combining the washings with the first filtrate. Gentle suction was applied to complete the collection of the seaweed extract. The residue was then discarded. The filtrate was concentrated under vacuo at a temperature below 50 degrees Celsius to the resulting crude extract of 20 mL *K. alvarezii* and 14 mL *K. striatus*. A 95% solution of Methanol was used as a solvent for the extraction process since methanol was recorded as

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the best solvent for extracting bioactive compounds, yielding a high content of plant secondary metabolites (Truong et al. 2019).

2.3 Preparation of Reagents

Serial dilution of extracts. Clean test tubes were taken and labeled. Stock solutions were then prepared for each *Kappaphycus* spp. crude extracts at 100 mg in 10 mL artificial seawater. Concentrations of 1000 µg/mL, 100 µg/mL, 10 µg/mL, and 1 µg/mL were prepared by serial dilution from the stock solution. Nine (9) replicates were prepared for each of the concentrations.

2.4 Cytotoxicity Test

For the determination of potential cytotoxicity of the *Kappaphycus* spp. crude extracts, brine shrimp lethality assay (BSLA) was performed. The method was adapted from Sarah et al. (2017) and initially developed by Meyer et al. (1982), with minor modifications to suffice the needed number of replicates and effectively detect brine shrimp nauplii.

Three (3) liters of distilled water were prepared in a rectangular container with 27 grams of rock salt to serve as artificial seawater during the hatching of brine shrimp eggs. An electric air pump was activated into the bottom of the container for proper and continuous aeration. Five (5) grams of brine shrimp eggs were then placed in the aerated seawater with proper illumination for optimal conditions of hatching (Fig. 3A). Hatched nauplii were observed after 24 hours of the hatching process. Ten nauplii were then carefully transferred to the prepared concentrations via a glass dropper (Fig. 3B). The number of surviving nauplii was then observed after 24 hours of exposure in each replicate of serially diluted concentrations (Fig. 3C). Artificial seawater served as the control variable.

2.5 Data Analysis

The nauplii mortality percentage for each concentration and the control was calculated, with the data presented as the mean along with the corresponding standard error. For each test tube, the numbers of dead and live nauplii were recorded, and the % death was determined as:

$$\% \text{ Death} = \frac{\text{Number of dead nauplii}}{\text{Number of dead nauplii} + \text{Number of live nauplii}} \times 100$$

Probit Analysis for the percent mortalities was done initially to calculate the median lethal concentrations (LC_{50}). Transformation of % mortality to probit values was done using Finney's Table (Finney 1952) adapted by Randhawa (2009). The 0% and 100% mortality corresponding to a probit value of 1.0334 and 8.9538, respectively, were followed according to Bliss (1935), which was also adopted by (Gomaa et al. 2021). Regression analysis was then performed to the probit values (y range) with their corresponding concentrations at log base 10 (x range). The resulting ***x variable 1*** and ***intercept*** values were then used to calculate the LC_{50} with the following formula:

$$Y = ax + b$$
$$x = \frac{(y-b)}{a}$$
$$LC_{50} = \text{antiLog } x$$

Wherein:

a = x variable 1 (slope); y = intercept value.

Analysis of the ***T-test*** was also done to determine the significant difference between the same concentrations of *K. alvarezii* and *K. striatus*. Spearman's rho correlation coefficient was also computed to determine the correlation of the concentrations to the percentage of mortalities for both extracts. Correlation analysis was computed through the JASP software version 0.14.1.0. Calculation of the descriptive statistics, probit analysis, LC_{50}, ***T-test,*** and formulation of graphs were done using the Microsoft Excel 2016 edition and Google Colab.

3 Results and Discussion

3.1 Effects of K. alvarezii and K. striatus on Brine Shrimp Larvae Mortality

The cytotoxic effect of bioactive compounds is frequently assessed using the brine shrimp lethality assay (BSLA). It serves as an initial investigation of toxicity among tested plant extracts (Ghosh et al. 2015, Kibiti & Afolayan 2016, Sarah et al. 2017, Sufian & Haque 2015, Syahmi et al. 2010), cytotoxicity testing of dental materials, heavy metals, cyanobacteria toxins, pesticides, fungus toxins, and among others (Sarah et al. 2017). Based on the results, data on both *K. alvarezii* and *K. striatus* showed potential bioactivity towards the tested nauplii. Mortalities were observed in each concentration after 24 hours of exposure for most replicates. Also, the control group had a very low mortality rate, which only accounts for 3% of

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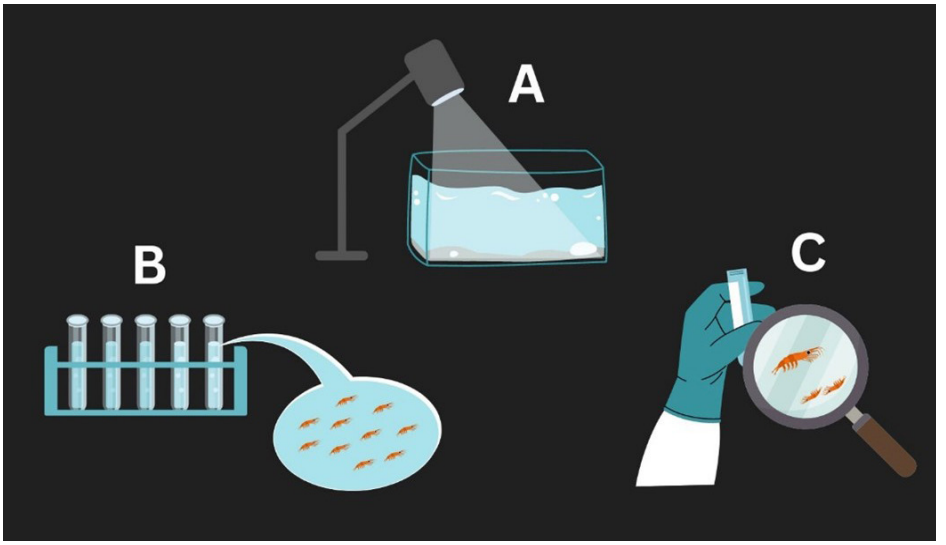

Figure 3. Illustration of the Brine Shrimp Lethality Assay Set-up. A) Brine shrimp hatching stage using a rectangular container with continuous aeration and proper illumination, B) Transfer of nauplii to the respective concentrations (10 nauplii per concentration), and C) Manual counting of nauplii after 24-hour exposure to treatments.

Table 1. Data on percent (%) mortality described as Means with Standard Error Mean (SEM) for both *Kappaphycus* spp extracts.

Concentrations	Mortality (%)									
	K. alvarezii					*K. striatus*				
	Mean	SEM	Min.	Max.	LC50 (µg/mL)	Mean	SEM	Min.	Max.	LC50 (µg/mL)
1000 µg/mL	88.9	6.8	40	100	38.9	32.2	4.6	10	50	2187.76
100 µg/mL	30	4.4	0	40		26.7	3.3	20	50	
10 µg/mL	20	2.9	10	30		6.7	1.7	0	10	
1 µg/mL	14.4	3.8	0	30		5.6	2.4	0	20	

its population, indicating the acceptability of the experiment (Sadat Sadeghi 2018).

The BSLA revealed distinct toxicity profiles between *K. alvarezii* and *K. striatus. K. alvarezii* demonstrated a significantly higher mortality rate than *K. striatus* across all tested concentrations. At the highest concentration (1000 µg/mL), *K. alvarezii* induced an average mortality of 88.9%, indicating a substantial toxic effect. While mortality decreased with lower concentrations, it remained notably higher than that of *K. striatus. K. striatus,* on the other hand, consistently exhibited lower mortality rates. Even at the highest concentration, mortality was only 32.2%, suggesting a significantly lower toxic potential than *K. alvarezii.* This trend persisted across all concentration levels.

The observed disparity in toxicity between *K. alvarezii* and *K. striatus* (Fig. 4) has significant implications for various applications. If these seaweeds are considered for use in food, pharmaceuticals, or cosmetics, the higher toxicity of *K. alvarezii* necessitates rigorous safety evaluations. Identifying the specific toxic compounds and their mechanisms of action is crucial for developing mitigation strategies or determining safe usage limits (Desideri et al. 2016). However, this also means that the higher toxicity exhibited by *K. alvarezii* compared to *K. striatus* suggests the presence of potentially bioactive compounds within *K. alvarezii* that could have pharmacological applications. Many drugs are derived from natural products that exhibit some toxicity, often refined through chemical modification or isolation of the active compound (Khan 2018, Thomford et al. 2018). This being said, the toxicity differences between *K. alvarezii* and *K. striatus* highlight the importance of species-specific toxicity assessments (Peng et al. 2022). Further research is warranted to characterize

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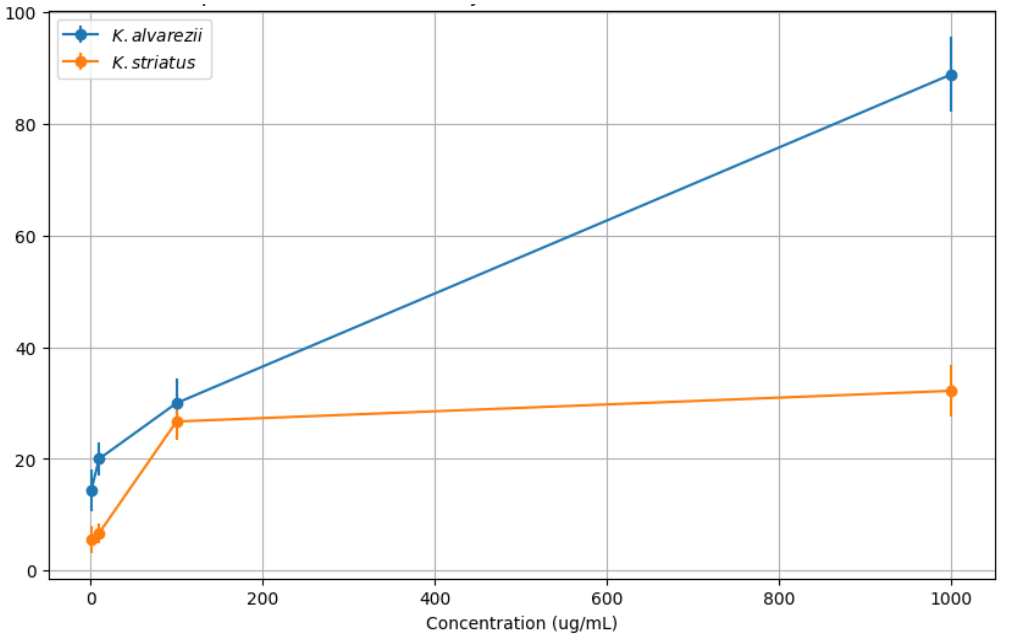

Figure 4. Graph showing the concentration-dependent toxicity of *Kappaphycus* species.

the toxic profiles of these seaweeds fully, identify potential risks, and explore their safe and sustainable utilization. Studies employing a wider range of concentrations, additional toxicity assays, and in vivo models are essential to evaluate the safety profile of these seaweeds comprehensively.

3.2 Median Lethal Concentration (LC_{50}) and correlation of treatments to mortalities.

For the analysis of the correlation between the level of concentrations and the percentage of mortalities, Spearman's rho correlation coefficients were employed (Table 2). The established level of concentrations and the percentage of mortalities showed a positive correlation with highly significant *p* values for both crude extracts of *K. alvarezii* and *K. striatus.* For *K. alvarezii*, the Spearman's rho value is 0.797 ($p<0.001$), while for *K. striatus*, the Spearman's rho value is 0.781 ($p<0.001$). The positive correlation between concentration and mortality rates for both *K. alvarezii* and *K. striatus*, as indicated by the highly significant Spearman's rho values, provides strong evidence for a concentration-dependent toxic effect of both seaweed extracts on brine shrimp larvae. This finding is consistent with the general toxicological principle that increasing exposure to a toxic or bioactive substance typically results in increased adverse effects (Vilas-Boas et al. 2021). Furthermore, the similar correlation coefficients for both species suggest that while there is a difference in the overall toxicity, they exhibit a comparable pattern of increasing toxicity with increasing concentration. This information is crucial for understanding the potential hazards of these seaweeds and determining safe exposure levels.

The cytotoxicity of both species, as indicated by their concentration-dependent toxicity on brine shrimp larvae, warrants further investigation into their potential bioactivity. While cytotoxicity is often associated with negative effects, it can also be a precursor to identifying valuable pharmacological compounds (Majolo et al. 2019). Many natural products with therapeutic properties exhibit cytotoxicity at certain concentrations. These compounds often serve as lead compounds for drug discovery and development (Chopra & Dhingra 2021). The concentration-dependent toxicity observed in both seaweed species suggests the presence of bioactive compounds that could potentially be harnessed for pharmaceutical applications.

The higher cytotoxicity of *K. alvarezii* compared to *K. striatus* is particularly intriguing. This could indicate a greater abundance or potency of bioactive compounds in *K. alvarezii.* However, further studies are required to isolate and characterize these compounds to determine their specific biological activities and potential therapeutic applications. It is essential to approach this potential with caution. While cytotoxicity is a preliminary indicator of bioactivity, it does not guarantee the presence of safe and effective drug candidates (Aware et al. 2022). Rigorous toxicity testing, pharmacological evaluation, and drug development processes are essential to ensure the safety and efficacy of any potential drug derived from these seaweeds. Hence, the observed cytotoxicity of *K. alvarezii*

Table 2. Data showing the correlation coefficient of percent mortalities from each extract in response to the established level of concentrations along with their respective LC_{50}

Species	Spearman's rho	*p* - value	LC_{50} (ppm)
K. alvarezii	0.797***	<0.001	38.9
K. striatus	0.781***	<0.001	2187.6

Note: **p<0.01, ***p<0.001

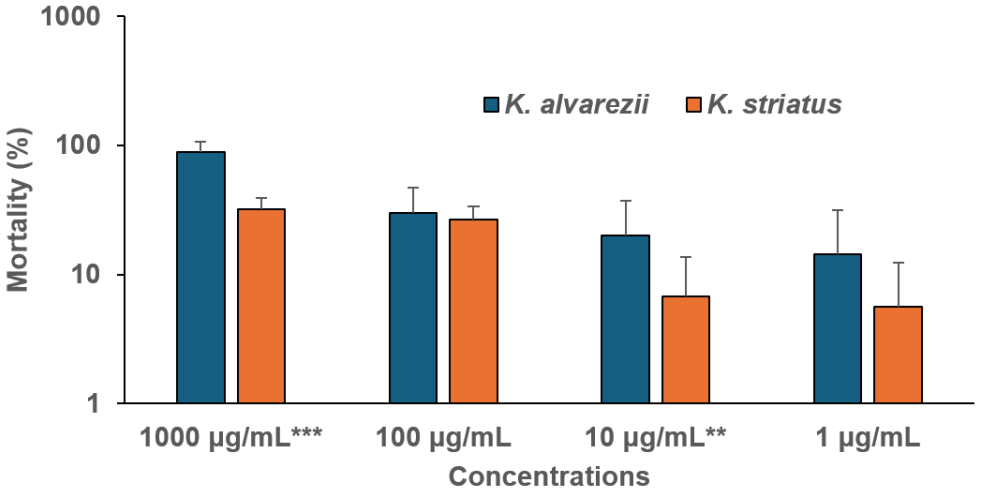

Figure 5. Graph showing the comparison of means (%mortality) for both *Kappaphycus* extracts. Concentrations with asterisks have *p* values <0.01** and <0.001***.

and *K. striatus* provides a foundation for exploring their potential as sources of bioactive compounds with pharmaceutical applications. However, comprehensive studies are necessary to unlock these species' full potential and develop safe and effective drug candidates.

The comparative analysis of mean mortality rates between *Kappaphycus alvarezii* and *Kappaphycus striatus* at varying concentrations provides further insights into their toxicity profiles. A consistent trend emerges, with *K. alvarezii* consistently demonstrating significantly higher mortality rates than *K. striatus* across all concentration levels. This observation reinforces the previous findings regarding the greater toxic potential of *K. alvarezii.* The most pronounced difference in mean mortality was observed at the highest concentration (1000 µg/mL), followed by the 10 µg/mL concentration (Fig. 5). These findings suggest a potential concentration-dependent increase in toxicity for both species, but with a more pronounced effect in *K. alvarezii.* The highly significant differences in mean mortality between the two species at the 1000 µg/mL and 10 µg/mL concentrations, as determined by the ***t***-test ($p < 0.001$ and $p < 0.01$, respectively), provide strong statistical support for the observed differences. This statistical significance strengthens the conclusion that the observed differences in mortality rates are not due to chance but are likely attributable to intrinsic differences in the toxicity of the two seaweed species. This strong statistical support further solidifies the notion that *K. alvarezii* possesses a significantly higher toxic potential than *K. striatus.* The concentration-dependent nature of the toxicity, particularly evident at higher concentrations, warrants further investigation to elucidate the underlying mechanisms and to assess the potential implications for various applications.

Median lethal concentration (LC_{50}) is defined as the concentration level of a particular substance killing half or 50% of the population of test samples, the Brine Shrimp nauplii, as used in the previous study (Orsine et al. 2012). LC_{50} is being considered in the study since the values vary less than LD_1 and LD_{99}, defined as the dosage needed to kill 1% or 99% of a particular test population, respectively (Gupta 2020). For this study, the differences in bioactivity were further supported by the evaluation of their respective LC_{50} (Table 2). The LC_{50} values provide quantitative support for the qualitative observations made in the previous analyses. The significantly lower LC_{50} value for *K. alvarezii* (38.9 µg/mL) compared to *K. striatus* (2187.76 µg/mL) unequivocally demonstrates the superior toxicity of *K. alvarezii.* This implies that a substantially lower concentration of *K. alvarezii* extract is required to induce mortality in 50% of the brine shrimp population compared to *K. striatus.*

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The substantial statistical difference (45.54, $p<0.0001$) between the LC50 values reinforces the conclusion that the observed difference in toxicity between the two seaweed species is highly unlikely to be due to chance (Pocock 2006). These findings further emphasize the potential of *K. alvarezii* as a source of bioactive compounds with cytotoxic properties. However, as previously mentioned, further investigation is necessary to isolate and characterize these compounds to determine their specific biological activities and potential therapeutic applications. It is crucial to note that while the LC_{50} values provide a quantitative measure of acute toxicity, they do not necessarily reflect the chronic toxicity or other potential adverse effects of these seaweed extracts (Pillai et al. 2021).

3.3 Biochemical composition from previous studies

Cytotoxicity assessments are pivotal in the preliminary evaluation of potential drug candidates. As Aslantürk (2018) noted, these assays are indispensable tools in in vitro studies. Their efficacy in identifying compounds that inhibit or halt cell proliferation makes them cornerstone methods in cancer research. The present study's findings align with this perspective. The markedly lower LC_{50} value of *K. alvarezii* compared to *K. striatus* strongly suggests a higher cytotoxic potential in the former species. This differential cytotoxicity profile indicates that *K. alvarezii* may harbor compounds with more potent biological activities, warranting deeper exploration.

Previous research has consistently demonstrated that *K. alvarezii* possesses a richer biochemical composition than *K. striatus,* particularly in polysaccharides and fat-soluble antioxidants (Ariano et al. 2021, Bhuyar et al. 2021). This disparity in chemical constituents likely plays a pivotal role in the observed differences in bioactivity between the two species.

The presence of these compounds in *K. alvarezii* may be correlated with its enhanced cytotoxic properties. By delving deeper into the specific compounds responsible for the observed cytotoxicity in *K. alvarezii,* researchers can identify potential lead molecules for therapeutic interventions. For example, studies have shown that certain polysaccharides derived from marine algae can exhibit anti-cancer properties by inhibiting cell proliferation and inducing apoptosis (Yao et al. 2022). Similarly, antioxidant compounds from marine algae have been investigated for their potential to protect against neurodegenerative diseases and cardiovascular disorders (Barbalace et al. 2019, Murray et al. 2018). Therefore, the richer biochemical composition of *K. alvarezii*, particularly its higher content of polysaccharides and fat-soluble antioxidants, provides a strong foundation for exploring its potential as a source of bioactive compounds with therapeutic applications. However, further research is necessary to isolate and characterize these compounds to fully understand their biological activities and safety profiles.

4. CONCLUSION

This study evaluated the cytotoxic effects of *K. alvarezii* and *K. striatus* on brine shrimp larvae. The results demonstrated a significant toxicity disparity between the two seaweed species. *K. alvarezii* consistently exhibited a markedly higher mortality rate across all tested concentrations, indicating a substantially greater toxic potential. A positive correlation between concentration and mortality was observed for both species, suggesting a concentration-dependent toxic effect. This finding is further supported by the LC_{50} values, with *K. alvarezii* exhibiting a significantly lower LC_{50}, indicating a higher acute toxicity. The higher cytotoxicity of *K. alvarezii* is potentially attributed to its richer biochemical composition, particularly in terms of polysaccharides and fat-soluble antioxidants from recent literature. This suggests the presence of bioactive compounds within *K. alvarezii* that could potentially have pharmacological applications. However, rigorous safety evaluations and further research are necessary to isolate and characterize these compounds, ensuring their safety and efficacy for therapeutic use. In conclusion, this study underscores the importance of species-specific toxicity assessments and highlights the potential of *K. alvarezii* as a source of bioactive compounds. While the higher toxicity necessitates careful handling and application, further research is warranted to explore its potential benefits and develop strategies for safe and sustainable utilization. Research in these areas could expand the market potential for the thriving seaweed industry in Caraga, Philippines.

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6. STATEMENT OF CONFLICT OF INTEREST

The authors declared that they have no conflict of interest associated with this research and the publication of this manuscript.

7. LITERATURE CITED

Ariano, A., Musco, N., Severino, L., De Maio, A., Tramice, A., Tommonaro, G., Damiano, S., Genovese, A., Olanrewaju, O. S., Bovera, F., & Guerriero, G. (2021). Chemistry of Tropical Eucheumatoids: Potential for Food and Feed Applications. *Biomolecules,* **11**(6), 804. https://doi.or

g/10.3390/biom11060804

Aslantürk, Ö. S. (2018). In Vitro Cytotoxicity and Cell Viability Assays: Principles, Advantages, and Disadvantages. In M. L. Larramendy & S. Soloneski (Eds.),*Genotoxicity—APredictableRisk to Our Actual World.*InTech.https://dorg/10.5772intechopen.71923

Aware, C. B., Patil, D. N., Suryawanshi, S. S., Mali, P. R., Rane, M. R., Gurav, R. G., & Jadhav, J. P. (2022). Natural bioactive products as promising therapeutics: A review of natural product-based drug development. S*outh African Journal of Botany,* **151**,512–528.https://doi.org/10.1016/j.sajb.2022.05.028

Barbalace, M. C., Malaguti, M., Giusti, L., Lucacchini, A.,Hrelia,S.,&Angeloni,C.(2019).Anti-Inflammatory Activities of Marine Algae in Neurodegenerative Diseases. I*nternational Journal of Molecular Sciences*,**20**(12),3061.https:doiorg10.3390ijms20123061

Bhuyar, P., Sundararaju, S., Rahim, M. H. Ab., Unpaprom, Y., Maniam, G. P., & Govindan, N. (2021). Antioxidative study of polysaccharides extracted from red (Kappaphycus alvarezii), green (Kappaphycus striatus) and brown (Padina gymnospora)marinemacroalgae/seaweed.*SNApplie Sciences,* **3**(4), 485. https://doi.org/10.1007/s42452-021-04477-9

Chopra, B., & Dhingra,A. K.(2021).Natural products: A lead for drug discovery and development. *Phytotherapy Research*, **35**(9),4660–4702.https://doi.org/10.1002/ptr.7099

Desideri, D., Cantaluppi, C., Ceccotto, F., Meli, M. A., Roselli, C., & Feduzi, L. (2016). Essential and toxic elements in seaweeds for human consumption. Journal of Toxicology and Environmental Health, Part A, 79(3), 112–122. https://doi.org/10.1080/15287394.2015.1113598

Ferraces-Casais, P., Lage-Yusty, M. A., Rodríguez-Bernaldo De Quirós, A., & López-Hernández, J. (2012). Evaluation of Bioactive Compounds in Fresh Edible Seaweeds. *Food Analytical Methods*, **5**(4), 828–834. https://doi.org/10.1007/s12161-011-9321-2

Filippini, M., Baldisserotto, A., Menotta, S., Fedrizzi, G., Rubini, S., Gigliotti, D., Valpiani, G., Buzzi, R., Manfredini, S., & Vertuani, S. (2021). Heavy metals and potential risks in edible seaweed on the market in Italy. *Chemosphere*, **263**, 127983. https://doi.org/10.1016/j.chemosphere.2020.127983

Ghosh, A., Banik, S., & Islam, Md. A. (2015). In vitro thrombolytic, anthelmintic, anti-oxidant and cytotoxic activity with phytochemical screening of methanolic extract of Xanthium indicum leaves. *Bangladesh Journal of Pharmacology,***10**(4), 854.https://doi.org/10.3329/bjp.v10i4.23829

Gomaa, S. A. S., Barakat, E. M. S., Salama, M. S., & El-Gohary, E. E. (2021). Effect of the Bacterium Paenibacillus larvae larvae on Vitellogenin Gene Expression of the Queen Honey Bee Apis mellifera L. *African Entomology,* **29**(1). https://doi.org/10.4001/003.029.0096

Guevara, B. Q. (2005). *A guidebook to plant screening: Phytochemical and biological* (Rev. ed). University of Santo Tomas Publishing House.

Gullón, P., Astray, G., Gullón, B., Franco, D., Campagnol, P. C. B., & Lorenzo, J. M. (2021). Inclusion of sea weeds as healthy approach to formulate new low-salt meatproducts. *Current Opinion in Food Science,* **40**, 20–25. https://doi.org/10.1016/j.cofs.2020.05.005

Gupta, P. K. (2020). Principles of Toxicology. In P. K. Gupta, *Problem Solving Questions in Toxicology:* (pp. 27–45). Springer International Publishing. https://doi.org/10.1007/978-3-030-50409-0 _3

Jarvis, T. A., & Bielmyer-Fraser, G. K. (2015). *Accumulation and effects of metal mixtures in two seaweed species.Comparative Biochemistry and Physiology PartC:Toxicology&Pharmacology,***171**,28–33.https://doi.org/10.1016/j.cbpc.2015.03.005

Khan, R. A. (2018). Natural products chemistry: *The emerging trends and prospective goals. Saudi Pharmaceutical Journal,* **26**(5), 739–753. https://doi.org/10.1016/j.jsps.2018.02.015

Kibiti, C. M., & Afolayan, A. J. (2016). Antifungal activity and brine shrimp toxicity assessment of Bulbine abys sinica used in the folk medicine in the Eastern Cape Province, South Africa. *Bangladesh Journal of Pharmacology,* **11**(2), 469. https://doi.org/10.3329/bjp.v11i2.24405

Majolo, F., De Oliveira Becker Delwing, L. K., Marmitt, D. J., Bustamante-Filho, I. C., & Goettert, M. I. (2019). Medicinal plants and bioactive natural compounds for cancer treatment: Important advances for drug discovery. *Phytochemistry Letters,* **31,** 196–207.https://doi.org/10.1016/j.phytol.2019.04.003

Malain, D., Regan, P. H., Bradley, D. A., Matthews, M., Al-Sulaiti, H. A., & Santawamaitre, T. (2012). An evaluation of the natural radioactivity in Andaman beach sand samples of Thailand after the 2004 tsunami. *Applied Radiation and Isotopes,* **70**(8), 1467–1474.https://doi.org/10.1016/j.apradiso.2012.04.017

Mateo, J. P., Campbell, I., Cottier-Cook, E. J., Luhan, M. R. J., Ferriols, V. M. E. N., & Hurtado, A. Q. (2021). Understanding biosecurity: Knowledge, attitudes and practices of seaweed farmers in the Philippines. *Journal of Applied Phycology,* **33**(2), 997–1010. https://doi.org/10.1007/s10811-020-02352-5

Meyer, B., Ferrigni, N., Putnam, J., Jacobsen, L., Nichols, D., & McLaughlin, J. (1982). Brine Shrimp: A Convenient General Bioassay for Active Plant Constituents. *Planta Medica,* **45**(05), 31–34. https://doi.org/10.1055/s-2007-971236

Murray, M., Dordevic, A. L., Ryan, L., & Bonham, M. P.

Volume 5 | Issue 2 | December 2024
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

(2018). An emerging trend in functional foods for the prevention of cardiovascular disease and diabetes: Marine algal polyphenols. *Critical Reviews in Food Science and Nutrition,* **58**(8), 1342–1358. https://doi.org/10.1080/10408398.2016.1259209

Orsine, J. V. C. (n.d.). *The acute cytotoxicity and lethal concentration (LC50) of Agaricus sylvaticus through hemolytic activity on human erythrocyte.*

Oucif, H., Benaissa, M., Ali Mehidi, S., Prego, R., Aubourg, S. P., & Abi-Ayad, S.-M. E.-A. (2020). Chemical Com position and Nutritional Value of Different Sea weeds from the West Algerian Coast. *Journal of Aquatic Food Product Technology,* **29**(1), 90–104. https://doi.org/10.1080/10498850.2019.1695305

Pati, M. P., Sharma, S. D., Nayak, L., & Panda, C. R. (2016). Uses of Seaweed and its Application to Human Welfare: *A Review. International Journal of Pharmacy and Pharmaceutical Sciences,* **8**(10),12. https://doi.org/10.22159/ijpps.2016v8i10.12740

Peng, Z., Guo, Z., Wang, Z., Zhang, R., Wu, Q., Gao, H., Wang, Y., Shen, Z., Lek, S., & Xiao, J. (2022). Spe cies-specific bioaccumulation and health risk assess ment of heavy metal in seaweeds in tropic coasts of South China Sea. *Science of The Total Environment,* **832**,155031.https://doi.org/10.1016/j.scitotenv. 2022.155031

Pillai, S. K., Kobayashi, K., Mathai, T., & Michael, M. (2021). Use of LC50 in aquatic regulatory toxicology-Disharmony in global harmonization of hazard classification of chemicals. *Ecotoxi cology and Environmental Contamination,***16**(1), 91–96. https://doi.org/10.5132/eec.2021.01.12

Pocock, S. J. (2006). The simplest statistical test: How to check for a difference between treatments. *BMJ*, **332**(7552),1256.https://doi.org/10.1136/bmj.332. 7552.1256

Randhawa, M. A. (2009). Calculation of LD50 values from the method of Miller and Tainter, 1944. J Ayub Med Coll Abbottabad, 21(3), 184-185.Rasonable, G., Seronay, R., & Asufre, G. (2023). Effects of Fish Farming on Sediment, Water Quality and Plank ton Communities in Barobo Coastal Waters in Lianga Bay, Surigao Del Sur, Philippines. *International Confe rence on Fisheries and Aquaculture,* 1–22. https://doi. org/10.17501/23861282.2023.8101

Rengasamy, K. Rr., Mahomoodally, M. F., Aumeeruddy, M. Z., Zengin, G., Xiao, J., & Kim, D. H. (2020). Bioac tive compounds in seaweeds: An overview of their biological properties and safety. *Food and Chemical Toxicology,* **135,** 111013. https://doi.org/10.1016/j.fct. 2019.111013

Sadat Sadeghi, M. (2018). Evaluation of toxicity and lethal concentration (LC50) of silver and selenium nanopa rticle in different life stages of the fish Tenualosa ilish (Hamilton 1822). *Oceanography & Fisheries Open Access Journal,* **7**(5). https:/doi.org/10.19080/ OFOAJ.2018.07.555722

Samonte, G. P. B. (2017). Economics of *Kappaphycus* spp. Seaweed Farming with Special Reference to the Cen tral Philippines. In A. Q. Hurtado, A. T. Critchley, & I. C. Neish (Eds.), *Tropical Seaweed Farming Trends, Problems and Opportunities* (pp. 147–154). Springer InternationalPublishing.https://doi.org/10.1007/9 78-3-319-63498-2_9

Santawamaitre, T., Malain, D., Al-Sulaiti, H. A., Matthews, M., Bradley, D. A., & Regan, P. H. (2011). Study of natural radioactivity in riverbank soils along the Ch ao Phraya river basin in Thailand. *Nuclear Instrume nts and Methods in Physics Research Section A: Accelerators,Spectrometers,Detectors and Associated Equipment,* **652**(1),920–924.https://doi.org/10.1016/j. nima.2010.10.057

Sarah, Q. S., Anny, F. C., & Misbahuddin, M. (2017). *Brine shrimp lethality assay. Bangladesh Journal of Phar macology,* **12**(2). https://doi.org/10.3329/bjp.v12i2. 32796

Senthil, A., Mamatha, B. S., Vishwanath, P., Bhat, K. K., & Ravishankar, G. A. (2011). Studies on development and storage stability of instant spice adjunct mix from seaweed (Eucheuma). *Journal of Food Science and Technology,* **48**(6), 712–717. https://doi.org/10.1007 /s13197-010-0165-3

Smith, J., Summers, G., & Wong, R. (2010). Nutrient and heavy metal content of edible seaweeds in New Zeala nd. *New Zealand Journal of Crop and Horticultural S cience,* **38**(1), 19–28. https://doi.org/10.1080/01140 671003619290

Sufian, Md. A., & Haque, M. R. (2015). Cytotoxic, throm bolytic, membrane stabilizing and anti-oxidant acti vities of *Hygrophila schulli. Bangladesh Journal of Pharmacology,* **10**(3), 692. https://doi.org/10.3329/b jp.v10i3.23718

Suyo, J. G. B., Le Masson, V., Shaxson, L., Luhan, M. R. J., & Hurtado, A. Q. (2021). Navigating risks and uncer tainties: Risk perceptions and risk management stra tegies in the Philippine seaweed industry. *Marine Policy,* **126,** 104408. https://doi.org/10.1016/j.mar pol.2021.104408

Syahmi, A. R. M., Vijayarathna, S., Sasidharan, S., Latha, L. Y., Kwan, Y. P., Lau, Y. L., Shin, L. N., & Chen, Y. (2010). Acute Oral Toxicity and Brine Shrimp Lethality of Elaeis guineensis Jacq., (Oil Palm Leaf) Methanol Extract. *Molecules,* **15**(11), 8111–8121. https://doi. org/10.3390/molecules15118111

Thomford, N. E., Senthebane, D. A., Rowe, A., Munro, D., Seele, P., Maroyi, A., & Dzobo, K. (2018). Natural Products for Drug Discovery in the 21st Century: Innovations for Novel Drug Discovery. *International Journal of Molecular Sciences,* **19**(6), 1578. https:// doi.org/10.3390/ijms19061578

Truong, D.-H., Nguyen, D. H., Ta, N. T. A., Bui, A. V., Do, T. H., & Nguyen, H. C. (2019). Evaluation of the Use of Different Solvents for Phytochemical Constituen ts, Antioxidants, and *In Vitro Anti-Inflammatory Acti*

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vities of Severinia buxifolia. Journal of Food Quality, **2019**, 1–9. https://doi.org/10.1155/2019/8178294

Vilas-Boas, A. A., Pintado, M., & Oliveira, A. L. S. (2021). Natural Bioactive Compounds from Food Waste: Toxi city and Safety Concerns. *Foods,* **10**(7), 1564. https://doi.org/10.3390/foods10071564

Wang, S., Wang, Q., Jiang, X., Han, X., & Ji, H. (2013). Compositional analysis of bio-oil derived from py rolysis of seaweed. *Energy Conversion and Manage ment,* **68,** 273–280. https://doi.org/10.1016/j.encon man.2013.01.014

Yao, W., Qiu, H.-M., Cheong, K.-L., & Zhong, S. (2022). Advances in anti-cancer effects and underlying mech anisms of marine algae polysaccharides. *Interna tional Journal of Biological Macromolecules*, **221,** 472 –485.https://doi.org/10.1016/j.ijbiomac.2022.09.055

Book:
Guevara, B. Q. (2005). A guidebook to plant screening: Phytochemical and biological (Rev. ed). University of Santo Tomas Publishing House.

Website:
Philippine Statistics Authority (2020). Fisheries Statistics of the Philippines. https://psa.gov.ph/

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Teachers' Work Burnout, Social Support, and Resilience Amidst Covid-19 Pandemic

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ABSTRACT

This study investigated the relationship between teachers' work burnout, perceived social support, and resilience during the COVID-19 pandemic. A descriptive-correlational research design was employed through a survey questionnaire administered to 124 teachers in Tago 3 District, Division of Surigao del Sur. Descriptive statistics and Pearson's Correlation Test were used for data analysis. The findings revealed that teachers generally exhibited low levels of emotional exhaustion and depersonalization, while their sense of personal accomplishment was high. High levels of perceived social support were reported across family, significant others, and friends, signifying strong external resources for emotional and practical support. The resilience level among teachers was normal. A weak, negative correlation was found between work burnout and social support, suggesting that increased social support is associated with reduced burnout, though other factors also contribute. A moderate, positive correlation was observed between work burnout and resilience, indicating that even resilient teachers may experience elevated burnout due to pandemic-related pressures and demands. The study concludes that strong social support networks serve as protective factors against burnout, and enhancing resilience is crucial for effective coping and adaptation to life's challenges. It is recommended that schools foster positive and safe workplaces and implement programs to strengthen peer support, collaboration, and teacher resilience.

Keywords: *work burnout, perceived social support, resilience*

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1 Introduction

The COVID-19 pandemic has caused unprecedented interruptions to different sectors around the world, among which the education system has encountered significant challenges (UNESCO 2020, Wajdi et al. 2020). Schools had to undergo a paradigm shift to continue delivering quality education through various learning models and platforms. The sudden transition from traditional in-person learning to online education presented a completely different experience for learners and educators, requiring rapid adaptation, often with limited alternative options. Teachers, as the frontline of this drastic change, were tasked with navigating new technologies, engaging students in virtual classrooms, and managing increased workloads in unfamiliar and demanding situations (Pokhrel & Chhetri 2021). The COVID-19 pandemic not only brought an abrupt transition in how teachers deliver education but reportedly affected their mental health in various ways (Kush et al. 2022, Jakubowski & Dominik 2021, Rabacal et al. 2020).

Work burnout is one mental health issue experienced by teachers. Work burnout is a psycholo gical condition that occurs as a prolonged negative reaction to chronic perceived personal stressors(Mas lach & Leiter 2016). These reactions are categorized into three dimensions: emotional exhaustion, which denotes a feeling of being emotionally overextended and tired by work; depersonalization, which is charac terized by a cynical attitude toward work and others;

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and a decline in personal accomplishment, which indicates a sense of ineffectiveness in one's professional life (Maslach et al. 2001).

Burnout is the physical, emotional, and mental state exhaustion (Piperac et. al 2021), triggered by extreme and continual stress, and is a growing concern in school settings (Langley-Evans 2023). Job burnout among teachers, caused by high demands of teaching tasks and prolonged hours (Wu et al. 2016), usually affects the teachers' teaching quality and well-being (Capone & Petrillo 2018, Domitrovich et al. 2016).

Amid these challenging times, social support has emerged as one of several potential psychological resources to counter the negative effects of burnout. Social support is the perception that family, friends, and others are available to offer psychological needs, material, and overall assistance during difficult times (Ioannou et al. 2019). Social support can help reduce the adverse effects of stress on mental health (Mikkola et al. 2018), correlated to reduced levels of burnout (Hou et al. 2020), and mediate the negative effects of burnout on health (Ruisoto et al. 2021). A high perceived social support is also associated with better physical and mental health outcomes (Uchino et al. 2012).

Seeking social support manages burnout and serves as their coping strategy (Cruz & Macalisang 2024). Resilience is another psychological resource defined as the capacity to recover from difficulties or adapt to challenging and adverse circumstances (Fletcher & Sarkar 2013), positively keep mental health even if subjected to difficulties due to various demands and limitations of the job (Chmitorz et al. 2018, Kangas-Dick and O'Shaughnessy 2020, Mansfield et al. 2016), helps deal with stress and trauma and bounce back from adversity with varying severity over a lifetime (Day and Gu 2014, Windle et al. 2011).

Individuals with higher levels of resilience were significantly less likely to experience burnout, particularly high emotional exhaustion, depersonalization, or a reduced sense of personal accomplishment (Nantsupawat et al., 2024)

The study on the interplay between work burnout, social support, and resilience is one important area that remains interesting, particularly among teachers facing the pressures of the pandemic. While there is evidence pointing out that social support and resilience can aid in alleviating burnout, few studies have investigated how these factors interact specifically within the framework of teaching during the COVID-19 pandemic.

Addressing this gap is essential for improving strategies that can help teachers strengthen their resilience and understand how to access appropriate social support for improved well-being. Hence, this study sought to investigate the levels of work burnout, social support, resilience, and the significant relationships among these variables.

2 Materials and Methods

Research Design

The study utilized a quantitative research method, specifically a descriptive-correlational design, which facilitated the researchers in gathering data through a survey questionnaire distributed to the identified sample size.

Sampling Technique

The researchers employed a complete enumeration method, selecting 124 elementary and secondary teachers from Tago 3 District, Division of Surigao del Sur, as participants during the data collection period. Most of the teacher participants were 30 years old or younger (Figure 1), predominantly female (Figure 2), and married (Figure 3).

Instruments Used

This study utilized a survey questionnaire using the three standardized tests, which served as the measures or instruments in this study: Maslach Burnout Inventory-Educators Survey (MBI-ES), Multidimensional Scale of Perceived Social Support (MSPSS), and Brief Resilience Scale (BRS).

The initial part of the survey questionnaire collected demographic data such as gender, age, and civil status. The MBI-ES 4th Edition comprises three dimensions: emotional exhaustion, depersonalization, and personal accomplishment. This scale measures job-related experiences, exploring how educators perceive work and interaction with colleagues (Maslach et al. 1986). The MSPSS measures the adequacy of social support from family, friends, and partners (Zimet et al. 1988), while BRS is a self-assessment tool to measure individual resiliency (Smith et al. 2008). The psychometric properties of MBI-ES were confirmed with Cronbach's alpha values of .90 for emotional exhaustion, .76 for depersonalization, and .76 for personal accomplishment and with reliability estimates of 0.88, 0.74, and 0.72, respectively

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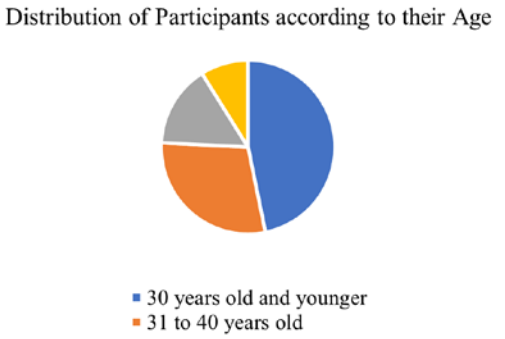

Figure 1. Age Distribution of Participants

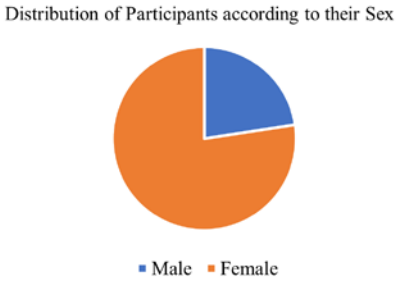

Figure 2. Sex Distribution of Participants

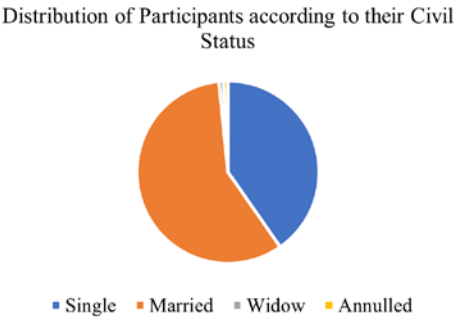

Figure 3. Civil Status Distribution of Participants

(Chalghaf et al. 2019). MPSS also showed good internal consistency for its three measured dimensions, with Cronbach's alpha coefficients of .91 for significant others, .87 for family, and .85 for friends, while yielding an overall reliability of .88. (Zimet et al.1988), BRS also demonstrated a very good internal consistency with Cronbach's alpha between .80 to .91 (Smith et al. 2008).

Data Gathering Procedure

The researchers ensured the approved letter from the Office of the District In-Charge, Division of Surigao del Sur, in conducting the study face-to-face since online platforms were not feasible for the target participants with challenges for internet connectivity. The researcher provided the participants with a formal letter and informed consent for voluntary participation and attached the research instrument. During the data gathering, the researchers followed the safety and minimum health standards provided by the Inter-Agency Task Force (IATF).

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Data Analysis Procedure

The data were tallied, tabulated, processed, and analyzed using frequency counts, percentages, and weighted mean. The study used Pearson's Correlation Test to determine the significant relationship between teachers' work burnout, perceived social support, and resiliency.

3 Results and Discussion

The Level of Work Burnout, Perceived Social Support, and Resiliency

The results on the level of burnout per dimension indicated that the overall weighted mean for teachers' emotional exhaustion was low (M = 2.37, SD = 1.05) (Table 1), suggesting low levels of fatigue and emotional depletion. Depersonalization was also low (M = 1.59, SD = 1.11) (Table 2), reflecting minimal feelings of detachment and impersonal attitudes. In contrast, personal accomplishment was high (M = 4.07, SD = 0.92) (Table 3), indicating a strong sense of competence and achievement in their work. Emotional exhaustion is described as the experience of emotional depletion resulting from stress, pressure, tension, and work overload related to one's work. As a result, individuals may constantly feel fatigued and feel low energy when facing the challenges of day-to-day responsibilities. Depersonalization is characterized by negative behaviors and cynicism in work relationships, while low personal accomplishment refers to feelings of incompetence and ineffective relating to work output (Maslach & Leiter 2016). Overall, the teachers' degree of burnout has a positive implication as they exhibited low levels of emotional exhaustion and depersonalization while maintaining a high sense of personal accomplishment. This suggests that teachers effectively maintain motivation and manage stress, contributing to a healthier work environment and improved work outcomes. Studies have shown that work burnout among teachers is highly influenced by psychosocial work determinants like stress, dissatisfaction, ambiguity of roles and responisbilites and even unmotivated students (Belay et al. 2023), heavy workload and high job demand (Belay et al. 2023, Tang et al. 2013), and designated administrative tasks (Musa et al. 2018).

Teachers showed a high level of perceived social support across all dimensions, including family (M = 5.92, SD = 1.60), significant others (M = 5.97, SD = 1.23), and friends (M = 5.61, SD = 1.31). Overall, the average score also reflects a high level of perceived social support (M = 5.83, SD = 1.31) (Table 4). The high perceived social support suggests that these relationships are accounted as strong external sources of emotional and practical support for teachers. Social support plays a vital role in keeping emotional well-being, coping with stress, and overcoming life's challenges (Harandi et al. 2017, Li et al. 2018). It serves as a direct predictor of life's significance and positively influencing self-affirmation while also being associated with lower levels of depression and anxiety (Hurd et al. 2013).

Meanwhile, most of the teachers experienced a normal or average level of resilience (M=3.21, SD = 0.37) (Table 5). Resilience is the capability to adjust and succeed in challenging situations, including difficult students, demanding workloads, and an unfavorable workplace atmosphere in schools (Mansfield et al. 2016). Teacher resilience plays a vital role in teaching and teacher education globally (Wang 2021), a significant factor that can help lessen burnout among educators (Polat & İskender 2018). Resilient teachers are better able to recover from drawbacks and sustain their motivation and vigor, which helps reduce stress levels (Daniilidou et al. 2020).

Significant Relationships in Teachers' Work Burnout, Perceived Social Support, and Resiliency

The teachers' level of work burnout and social support showed a weak and negative correlation ($r=-0.222$, $p=0.013$). Its p-value is less than 0.05, thus indicating that the relationship between the teachers' burnout and social support is statistically significant. The negative correlation coefficient indicates that the direction of its relationship is inversely related, which means that as social support increases, levels of work burnout among teachers tend to decrease. However, the weak strength of this correlation indicates that while social support may help reduce burnout, other factors likely contribute to the burnout levels experienced by teachers. Similar findings also found that social support has been correlated with burnout (Hou et al. 2020). It highlighted the substantial connection between social support and teacher burnout, suggesting that strong social support from colleagues (internal support within the educational workplace) and reassurance and empowerment from significant individuals, such as family and friends (external support outside the educational workplace), can help alleviate burnout and defend from negative consequences (Fiorilli et al. 2019, Marcionetti &

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Table 1. Level of Emotional Exhaustion of Participants

Level	*f*	*%*	Mean ± Standard Deviation
Never	*31*	*25.0*	2.37 ± 1.05
Very low	43	34.7	
Low	26	21.0	
Moderate	19	15.3	
High	5	4.0	
Total	**124**	**100.0**	

Legend: 0-0.99= Never; 1.00 – 1.44 = Very Low; 1.45 – 2.44 = Low; 2.45 – 3.44 = Moderate; 3.45 – 4.44 = High; & 4.45 – 5.00 = Very High

Table 2. Level of Depersonalization (DP) of Participants

Level	*f*	*%*	Mean ± Standard Deviation
Never	63	50.8	1.59 ± 1.11
Very low	32	25.8	
Low	21	16.9	
Moderate	8	6.5	
Total	**124**	**100.0**	

Legend: 0-0.99= Never; 1.00 – 1.44 = Very Low; 1.45 – 2.44 = Low; 2.45 – 3.44 = Moderate; 3.45 – 4.44 = High; & 4.45 – 5.00 = Very High

Table 3. Level of Personal Accomplishment (PA) of Participants

Level	*f*	*%*	Mean ± Standard Deviation
Never	1	.8	2.37 ± 1.05
Very low	4	3.2	
Low	22	17.7	
Moderate	49	39.5	
High	43	34.7	
Very High	5	4.0	
Total	**124**	**100.0**	

Legend: 0-0.99= Never; 1.00 – 1.44 = Very Low; 1.45 – 2.44 = Low; 2.45 – 3.44 = Moderate; 3.45 – 4.44 = High; & 4.45 – 5.00 = Very High

Table 4. Level of Perceived Social Support of Participants according to its Three Domains of MSPSS

Indicators	*Mean*	Std. Deviation	Interpretation
Family	5.92	1.6	High
Significant Others	5.97	1.23	**High**
Friends	5.61	1.11	High
Total	5.83	1.31	High

Legend: 1.00 – 2.9 = Low Support; 3 – 5 = Moderate Support; 5.1– 7 = High Support

Table 5. Level of Resilience of Participants

Level	*%*	Mean ± Standard deviation
Low Resilience	16.1	3.21 ± 0.37
Normal Resilience	83.9	
Total	100.0	

Legend: 1.00 – 2.99 = Low Resilience; 3 – 4.30 = Normal Resilience; 4.31– 5 = High Resilience

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Table 6. Relationship among Teachers' Work Burnout, Perceived Social Support, and Resilience

Null hypothesis, Ho	[a]Correlation Coefficient r	p-value	Statistical Decision	Remarks
There is no significant relationship between the teachers' level of work burnout and social support.	-0.222	0.013	Reject Ho at α=0.05	Inversely related; the strength of the relationship is weak.
There is no significant relationship between the teachers' level of work burnout and resilience.	0.322	0.000	Reject Ho at α=0.05	Directly related; the strength of the relationship is moderate.

Castelli 2023).

Social support can effectively lighten occupational burnout and enhance job satisfaction, which in turn helps individuals maintain good psychological health (Gündüz et al. 2019).

In terms of teachers' level of work burnout and resilience, it showed a moderate and positive correlation (r=.32, p <.001). Its p-value is less than 0.05, suggesting that relationship between the teachers' burnout and resiliene is statistically significant. This finding also corresponds to the existing literature, which showed that burnout and resilience are correlated among teachers (Li 2023, García & Gambarte 2019). Teachers with meager strategies for resilience are more susceptible to the harmful effects of stress and burnout. While those with high resilience skills are better equipped to cultivate personal resources that help them lessen the negative impacts of their workplace (Ferradás et al. 2019).

4 Conclusions and Recommendations

Teachers in this study experienced low levels of emotional exhaustion and depersonalization but with a high level of a sense of personal accomplishment, hence generally demonstrating a lowlevel of work burnout. The low level of work burnout may be attributed to having the external resources of their strengths, such as their social support from family, friends, and significant others, and having considerable internal or psychological strength, such as being resilient, which have helped teachers endure all the challenges and difficulties that they were facing related to their work during COVID-19 pandemic. These external and internal resources potentially serve as their protective factors. The inverse direction of the relationship between social support and work burnout means that as social support increases among teachers, their level of work burnout also decreases. Its weak correlation suggests that though social support has a significant and positive consequence in reducing burnout, other important factors can also help teachers deal with their work burnout, which serves as a point for further studies. The observed result of having a moderate and positive correlation between work burnout and resilience suggests that though teachers exhibited a high level of resilience, they still experienced a high level of work burnout at the time of the survey.

Given the significant role of social support in reducing burnout, it is recommended that schools actively cultivate a positive workplace through collaboration, peer support, open communication, and a sense of camaraderie. Additionally, building resilience among teachers is essential for effectively coping with challenges, adapting to change, developing a positive mindset, and constructively recovering from setbacks in life.

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5 Statement of Conflict of Interest

The authors state that they have no conflicts of interest.

6 Literature Cited

Belay, A. A., Gasheya, K. A., Engdaw, G. T., Kabito, G. G., & Tesfaye, A. H. (2023). Work-related burnout among

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public secondary school teachers is significantly influenced by the psychosocial work factors: A cross-sectional study from Ethiopia. *Frontiers in Psycho logy,* **14.** https://doi.org/10.3389/fpsyg.2023.1215421

Capone, V., & Petrillo, G. (2018). Mental health in teachers: Relationships with job satisfaction, efficacy beliefs, burnout and depression. *Current Psychology,* **39**(5), 1757-1766.https://doi.org/10.1007/s12144-018-98787

Chalghaf, N., Guelmami, N., Slimani, M., Del Puente, G., Re, T. S., Zerbetto R,, Maldonado Briegas, J. J., Gug lielmi, O., Garbarino, S., & Azaiez, F. (2019). Frontiers in Psychology. Development and Prelimi nary Validation of the "Teacher of Physical Educa tion Burnout Inventory" (TPEBI) in Arabic Language: *Insights for Sports and Occupational Psychology*, **10.**

Collie, R. J., & Martin, A. J. (2017). Teachers' sense of adap tability: Examining links with perceived autonomy support, teachers' psychological functioning, and students' numeracy achievement. *Learning and Indi vidual Differences,* **55**, 29-39. https://doi.org/10.1016/j.lindif.2017.03.003

Chmitorz,A.,Kunzler,A.,Helmreich,I.,Tüscher,O.,Kalisch, R., Kubiak, T., Wessa, M., & Lieb, K. (2018). Intervention studies to foster resilience – A systematic review and proposal for a resilience framework in future intervention studies. *Clinical Psychology Review,* **59,** 78-100. https://doi.org/10.1016/j.cpr.2017.11.002

Daniilidou, A., Platsidou, M., & Gonida, E. (2020). Primary school Teachers´Resilience: Association with teacher self-efficacy, burnout and stress. *Electronic Journal of Research in Education Psychology,* **18** (52),549-582.https://doi.org/10.25115/ejrep.v18i52.3487

Day, C., & Gu, Q. (2014). Response to Margolis, Hodge and Alexandrou: Misrepresentations of teacher resilience and hope. *Journal of Education for Teaching*, **40**(4), 409-412. https://doi.org/10.1080/02607476.2014.948707

De la Cruz, J. M., & Macalisang, D. (2024). The pheno menon of teachers' burnout: Its implication for job satisfaction. *Journal of Interdisciplinary Perspectives,* **2**(8). https://doi.org/10.69569/jip.2024.0203

Demir Polat, D., & İskender, M. (2018). Exploring tea chers' resilience in relation to job satisfaction, burn out, organizational commitment and perception of organizational climate. *International Journal of Psychology and Educational Studies,* **5**(3), 1-13. https://doi.org/10.17220/ijpes.2018.03.001

Domitrovich, C. E., Bradshaw, C. P., Berg, J. K., Pas, E. T., Becker, K. D., Musci, R., Embry, D. D., & Ialongo, N. (2016). How do school-based prevention pro grams impact teachers? Findings from a randomized trial of an integrated classroom management and social-emotional program. *Prevention Science,* **17**(3), 325-337. https://doi.org/10.1007/s11121-015-0618-z

Einav, M., Confino, D., Geva, N., & Margalit, M. (2024). Teachers' burnout – The role of social support, grati tude, hope, entitlement and loneliness. *International Journal of Applied Positive Psychology,* **9**(2), 827-849. https://doi.org/10.1007/s41042-024-00154-5

Fasihi Harandi, T., Mohammad Taghinasab, M., & Dehghan Nayeri, T. (2017). The correlation of social support with mental health: A meta-analysis. *Elec tronic Physician,* **9**(9), 5212-5222. https://doi.org/10.19082/5212

Ferradás, M. D., Freire, C., García-Bértoa, A., Núñez, J. C., & Rodríguez, S. (2019). Teacher profiles of psycho logical capital and their relationship with burnout. *Sustainability,* **11**(18), 5096. https://doi.org/10.3390/su11185096

Fiorilli C, Benevene P, De Stasio S, Buonomo I, Romano L, Pepe A and Addimando L (2019) Teachers' Burnout: The Role of Trait Emotional Intelligence and Social Support. *Front. Psychol.* 10:2743. doi: 10.3389/fpsyg.2019.02743

Fletcher, D., & Sarkar, M. (2013). Psychological resilience. *European Psychologist,* **18**(1),12-23.https://doiorg/10.1027/1016-9040/a000124

García, M. I. , Gambarte M. I. (2019). Relationships between the dimensions of resilience and burnout in primary school teachers. *International Electronic Journal of Elementary Education*, **12**(2), 189-196. https://doi.org/10.26822/iejee.2019257666

Gündüz, N. (2019). The impact of perceived social support on anxiety, depression and severity of pain and burnout among Turkish females with Fibromyalgia. *Archives of Rheumatology,* **34**(2), 186-195. https://doi.org/10.5606/archrheumatol.2019.7018

Hou, T., Zhang, T., Cai, W., Song, X., Chen, A., Deng, G., & Ni, C. (2020). Social support and mental health among health care workers during coronavirus disease 2019 outbreak: A moderated mediation model. *PLOS ONE,* **15**(5), e0233831. https://doi.org/10.1371/journal.pone.0233831

Hurd, N. M., Stoddard, S. A., & Zimmerman, M. A. (2013). Neighborhoods, social support, and African Ameri can adolescents' mental health outcomes: A multile vel path analysis. *Child Development,* **84**(3), 858-874. https://doi.org/10.1111/cdev.12018

Ioannou, M., Kassianos, A. P., & Symeou, M. (2019). Coping With Depressive Symptoms in Young Adults: Percei ved Social Support Protects Against Depressive Symptoms Only Under Moderate Levels of Stress. *Frontiers in Psychology,* **9**.https://doi.org/10.3389/fpsyg.2018.02780

Jakubowski, T., & Sitko-Dominik, M. (2021). Teachers' mental health during the first two waves of the CO VID-19 pandemic in Poland. v1. https://doi.org/10.17504/protocols.io.bseknbcw

Kangas-Dick, K., & O'Shaughnessy, E. (2020). Interven

tions that promote resilience among teachers: A systematic review of the literature. *International Journal of School & Educational Psychology*, **8**(2), 131-146. https://doi.org/10.1080/21683603.2020.1734125

Kush, J. M., Badillo-Goicoechea, E., Musci, R. J., & Stuart, E. A. (2022). Teachers' mental health during the COVID-19 pandemic. *Educational Researcher,* **51**(9), 593-597.https://doi.org/10.3102/0013189x221134281

Langley-Evans, S. C. (2023). Burnout: The peril stalking academics and researchers. *Journal of Human Nutrition and Dietetics*, **36**(3), 588-591. https://doi.org/10.1111/jhn.13135

Li, M., Eschenauer, R., & Persaud, V. (2018). Between avoidance and problem solving: Resilience, self-efficacy, and social support seeking. *Journal of Counseling & Development*, **96**(2), 132-143.https://doi.org/10.1002/jcad.12187

Li, S. (2023). The effect of teacher self-efficacy, teacher resilience, and emotion regulation on teacher burnout: A mediation model. *Frontiers in Psychology*, **14**. https://doi.org/10.3389/fpsyg.2023.1185079

Mansfield, C. F., Beltman, S., Broadley, T., & Weatherby-Fell, N. (2016). Building resilience in teacher education: An evidenced informed framework. *Teaching and Teacher Education,* **54,** 77-87. https://doi.org/10.1016/j.tate.2015.11.016

Marcionetti, J., & Castelli, L. (2023). The job and life satisfaction of teachers: A social cognitive model integrating teachers' burnout, self-efficacy, dispositional optimism, and social support. *International Journal for Educational and Vocational Guidance*, **23**(2), 441-463. https://doi.org/10.1007/s10775-021-09516-w

Maslach C., Jackson S. E. (1981). *The measurement of experienced burnout. J. Organ. Behav.* **2** 99–113. 10.1002/job.

Maslach, C. (1986). Stress, burnout, and workaholism. Professionals in distress: *Issues, syndromes, and solutions in psychology*, **53**-75. https://doiorg/10.1037/10056-004

Maslach C., Jackson S. E. (1986). *Maslach Burnout Inventory Manual*, 2 Edn Palo Alto, CA: Consulting Psychologists Press

Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry*, **15**(2), 103-111. https://doi.org/10.1002/wps.20311

Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory Manual. 3rd ed. Mountain View: CPP, Inc.; 1996

Maslach C., Leiter M. P. (2008). Early predictors of job burnout and engagement. *Journal of Applied Psychology* **93** 498–512. 10.1037/0021-9010.93.3.498

Maslach, C., Schaufeli, W. B., and Leiter, M. P. (2001). Job burnout. *Annual Review of Psychology*. **52**, 397–422. doi: 10.1146/annurev.psych.52.1.397

Mikkola, L., Suutala, E., & Parviainen, H. (2018). Social support in the workplace for physicians in specialization training. *Medical Education Online*, **23**(1), 1435114. https://doi.org/10.1080/10872981.2018.1435114

Musa, N. A., Moy, F. M., & Wong, L. P. (2018). Prevalence and factors associated with poor sleep quality among secondary school teachers in a developing country. *Industrial Health*, **56**(5), 407-418. https://doi.org/10.2486/indhealth.2018-0052

Nantsupawat, A., Kutney-Lee, A., Abhicharttibutra, K., Wichaikhum, O., & Poghosyan, L. (2024). Exploring the relationships between resilience, burnout, work engagement, and intention to leave among nurses in the context of the COVID-19 pandemic: A cross-sectional study. *BMC Nursing,* **23**(1). https://doi.org/10.1186/s12912-024-01958-1

Piperac, P., Todorovic, J., Terzic-Supic, Z., Maksimovic, A., Karic, S., Pilipovic, F., & Soldatovic, I. (2021). The validity and reliability of the Copenhagen Burnout Inventory for examination of burnout among preschool teachers in Serbia. *International Journal of Environmental Research and Public Health,* **18**(13), 6805. https://doi.org/10.3390/ijerph18136805

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. *Higher Education for the Future,* **8**(1), 133-141. https://doi.org/10.1177/2347631120983481

Rabacal, J. S., Oducado, R. M. F., & Tamdang, K. A. (2020). COVID-19 Impact on the Quality of Life of Teachers: A Cross-sectional Study. *Asian Journal for Public Opinion Research*, **8**(4), 478–492. https://doi.org/10.15206/ajpor.2020.8.4.478

Ruisoto, P., Ramírez, M. R., García, P. A., Paladines-Costa, B., Vaca, S. L., & Clemente-Suárez, V. J. (2021). Social support mediates the effect of burnout on health in health care professionals. *Frontiers in Psychology,* **11**. https://doi.org/10.3389/fpsyg.2020.623587

Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine*, **15**(3), 194-200. https://doi.org/10.1080/10705500802222972

Tang, J. J., Leka, S., & MacLennan, S. (2013). The psychosocial work environment and mental health of teachers: A comparative study between the United Kingdom and Hong Kong. *International Archives of Occupational and Environmental Health,* **86**(6), 657-666. https://doi.org/10.1007/s00420-012-0799-8

Uchino, B. N., Bowen, K., Carlisle, M., & Birmingham, W. (2012). Psychological pathways linking social support to health outcomes: A visit with the "ghosts" of research past, present, and future. S*ocial Science & Medicine*, **74**(7), 949-957. https://doi.org/10.1016/j.socscimed.2011.11.023

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Wang, Y. (2021). Building teachers' resilience: Practical applications for teacher education of China. *Frontiers in Psychology,* **12**. https://doi.org/10.3389/fpsyg.2021. 738606

Wajdi, M. B. N., Kuswandi, I., Al Faruq, U., Zulhijra, Z., Khairudin , K., & Khoiriyah, K. (2020). Education Policy Overcome Coronavirus, A Study of Indonesi ans. *Journal of Education and Technology*, **3** (2), 96-106.https://doi.org/10.29062/edu.v3i2.42

Windle, G., Bennett, K. M., & Noyes, J. (2011). A metho dological review of resilience measurement scales *Health and Quality of Life Outcomes*, 9(1), 8. https:// doi.org/10.1186/1477-7525-9-8

Wu X. C., Qi Y. J., Yu R. R., Zang W. W. (2016). Revision of Chinese primary and secondary school teachers' job burnout questionnaire. *Chinesse Journal of Clini cal Psych*ology **24** 856–860.10.16128/j.cnki.1005-3611.2016.05.020

Zimet, G. D., Dahlem, N. W., Zimet, S. G., and Farley, G. K. (1988). The multidimensional scale of perceived so cial support. *Journal of Personality Assessment*.**52**, 30–41.

Zhang, L., Pang, J., & Zhu, F. (2022). Effect of perceived social support on Psychache: Mediating effect of psy chological resilience. *Iranian Journal of Public Hea lth.* https://doi.org/10.18502/ijph.v51i2.8691

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