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Original Article

Studies on the Prevalence Rate of Neoplastic Growth in Fish Johniuss Dussumieri (Valenciennes, 1833) of Karachi Coast Due to Polluted Sea Environment

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ABSTRACT

Background: With the growing concern over the impacts of environmental pollution on marine life, this study addresses the critical issue of neoplastic growth in fish populations. The increasing prevalence of tumors in fish due to contaminated marine environments has raised alarms about ecosystem health and public health implications.

Objective: The primary objective of this research was to assess the prevalence and seasonal variation of neoplastic growth in fish populations, particularly focusing on the impact of environmental pollution.

Methods: Fish specimens were collected from various markets and examined for neoplastic growth. The study employed observational techniques, statistical analyses including ANOVA and Duncan's Multiple Range Test, and assessed seasonal variations from January 2019 to December 2022.

Results: A total of 2,373 fish were examined, with 193 cases of neoplastic growth identified, indicating a substantial prevalence of tumors. The statistical analysis revealed significant variations in tumor prevalence, with a notable correlation to environmental factors.

Conclusion: The study concludes that environmental pollution significantly impacts the prevalence of neoplastic growth in fish populations. This has profound implications for marine ecology and public health, emphasizing the need for effective environmental management and pollution control measures.

Keywords: Neoplastic growth, Environmental pollution, Marine life, Public health, Fish populations, Seasonal variation, Tumor prevalence.

INTRODUCTION

Incorporating the findings of various studies, the exploration of marine life in the context of environmental pollution and its impact on public health becomes increasingly relevant (1). The research by Ahsan et al. (2020) delved into the chemical and economic aspects of pesticide contamination in marine fisheries, highlighting the significant risks that marine pollution poses to the environment and various non-target organisms, including microorganisms, insects, seaweeds, fish, and mangroves along the Karachi Coast (2). Their investigation into fish and shellfish samples for pesticide contamination underscores the urgent need to address marine environment pollution (3).

Similarly, the work of Yu et al. (2014) demonstrated that fish farm debris could be efficiently used by aquatic organisms, indicating a complex interaction within marine ecosystems (4). This is complemented by Woolley et al. (2014), who investigated factors like temperature, light source, and oxygen conditions, influencing initial swimbladder inflation, growth, and survival of yellowtail kingfish larvae (5). Such studies reveal the delicate balance of marine life and how external factors, including pollution, can disrupt it (6).

Adding to this body of knowledge, Holopainen et al. (2022) focused on the population ecology, growth rate, and physico-chemical environment of European perch in the western Baltic Sea (7). They found that while the growth rate of this fish population was high, there were no significant differences in growth between estuarine and freshwater populations, suggesting that environmental factors might play a less pronounced role than previously thought (8).

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Furthermore, Vandana et al. (2021) reported on hepatic microsporidiosis in brackish water fish, highlighting the presence of parasites in marine environments and their implications for fish health (9). Mehar et al. (2022) expanded this understanding by observing the levels of heavy metals in fish tissues from the Karachi and Gwadar coasts of Pakistan, concluding that the Karachi environment was more polluted due to industrial activities and heavy sea traffic (10, 11).

The integration of these studies paints a comprehensive picture of the challenges facing marine ecosystems, particularly in the context of pollution and its impact on fish health (12, 13). This understanding is crucial for public health, as the health of marine life directly affects the safety and nutritional value of seafood consumed by humans (14). The findings emphasize the importance of monitoring and mitigating environmental pollutants to protect both marine life and human health (15). Effective management and policy measures are essential to preserve these vital ecosystems, ensuring the sustainability of fish populations and the safety of seafood for human consumption (16).

MATERIAL AND METHODS

In this observational cross-sectional study, our team set out to investigate the prevalence of neoplastic growth in various fish species, with a focus on Johniuss dussumieri, across multiple fish markets. The study commenced with the meticulous collection of 2,373 individual fish specimens from several locations, including the Fish Harbor, Empress Market, West Wharf, Water Pump, and other local markets. These diverse markets were chosen deliberately to ensure a representative sample of the regional fish population. The primary criterion for selecting specimens was the visible presence of neoplasms, aimed at detecting and analyzing the extent of tumor growth in the fish population.

Each fish underwent a thorough visual inspection conducted by a team of trained marine biologists to identify signs of neoplastic growth. Special attention was given to the species Johniuss dussumieri, as initial observations indicated a higher incidence of tumors in this group. Alongside the visual examination, detailed records of each specimen, including species, size, and apparent health status, were meticulously kept. Representative samples of tumors, when identified, were collected for subsequent histological analysis to confirm the neoplastic nature of the growths.

The statistical analysis of the data formed a crucial part of the study. Descriptive statistics were employed to summarize the data, providing insights into the basic features of the sample population and measures of neoplastic growth. This was complemented by the use of descriptive measures such as means, medians, and ranges, which were calculated for various parameters, including the size of the neoplastic growths and the age of the fish. To delve deeper into the data, an Analysis of Variance (ANOVA) was conducted. This was aimed at examining the differences in the prevalence of neoplastic growth among the different species and across the various markets. Duncan's Multiple Range Test was then applied for post-hoc comparisons between groups, enabling the identification of specific patterns and differences in tumor prevalence.

Furthermore, to understand the impact of environmental factors such as seasonal changes on neoplastic growth, the data was categorized and analyzed based on the time of year the specimens were collected. This approach allowed for an exploration of potential seasonal patterns in the incidence of neoplasms, shedding light on environmental influences that might affect tumor development in these fish species.

Overall, the study's design, from the comprehensive collection and careful examination of a wide range of fish specimens to the detailed statistical analysis, underscored our commitment to thoroughly understanding the prevalence and characteristics of neoplastic growth in fish, particularly in the context of environmental factors and public health implications.

RESULTS

The seasonal index of neoplastic growth in fish from January 2019 to December 2022, as shown in Table 1, revealed a total of 2,373 fish examined over the four-year period. Out of these, 193 instances of neoplastic growth were identified, resulting in an overall prevalence rate of 12%. The highest prevalence rates were observed in February (14% with 39 cases out of 275 fishes examined) and June (12% with 25 cases out of 202 examined), while the lowest rates were noted in April and December (both at 4%).

The statistical analysis of neoplastic growth in the fish collected from 2019 to 2022. In the 193 cases of neoplastic growth observed, the minimum number of growths recorded in an individual fish was 5, and the maximum was 39. The mean number of neoplastic growths across all cases was 17.33, with a standard deviation of 10.71, indicating a considerable variance in the extent of neoplastic growth among the infected fish.

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Table 1 Seasonal Index of Parameters in Fishes from January 2019 to December 2022

Month	No. of Fishes Examined	Total No. of Neoplastic Growth	Prevalence Rate% Neoplastic Growth			
Jan	233	28	12%			
Feb	275	39	14%			
Mar	208	11	5%			
Apr	125	5	4%			
May	185	10	5%			
Jun	202	25	12%			
Jul	205	26	13%			
Aug	166	8	5%			
Sep	150	12	8%			
Oct	260	24	9%			
Nov	224	14	6%			
Dec	140	6	4%			
TOTAL	2373	193	100%			
Total No. of neoplastic Growth		N	Min	Max	Mean	Std. Dev
		193	5	39	17.33	10.71

According to Table 2, the Analysis of Variance (ANOVA) and Duncan's Multiple Range Test for the seasonal index of parameters in fishes from January 2016 to December 2019 showed significant variations. The mean number of fishes examined each month varied greatly, with the highest in January (93 ± 12.31) and the lowest in June (30 ± 4.17). The mean total number of neoplastic growths also showed significant monthly variations, ranging from a high of 10 ± 1.87 in January to a low of 1 ± 0.25 in April. The F-Value Main Effect was significant for both the number of fishes examined (5.387) and the total number of neoplastic growths (13.06), with an LSD (Least Significant Difference) of 25.19 and 2.69, respectively.

Table 2 Analysis of Variance and Duncan's Multiple Range Test of Seasonal Index of Parameters

S. No.	Month	No. of Fishes Examined Mean	Total No. Of Neoplastic Growth Mean
1	Jan	93 ±12.31a	10 ± 1.87 a
2	Feb	69 ± 10.87abc	6 ± 2.87 a
3	Mar	42 ± 4.90cd	3 ± 0.03 b
4	Apr	33 ± 4.33d	1 ± 0.25 b
5	May	46 ± 5.46cd	3 ± 065 b
6	Jun	30 ± 4.17d	4 ± 0.71 b
7	Jul	29 ± 4.27d	4 ± 0.75b
8	Aug	42 ± 12.47d	2 ± 0.71b
9	Sep	38 ± 3.23d	3 ± 0.71 b
10	Oct	65 ± 5ab	6 ± 2.19 b
11	Nov	56 ± 4.76bcd	4 ± 1.04 b
12	Dec	35 ± 8.66d	2 ± 0.50 b
F-Value Main Effect		5.387 ***	13.06***
LSD		25.19	2.69

Collectively, the data from these tables indicate a clear seasonal pattern in the prevalence of neoplastic growths in fish, with notable fluctuations across different months and years. The variability in the extent of neoplastic growth among individual fish suggests environmental and possibly other factors influencing tumor development. The significant differences in monthly averages, as demonstrated by the ANOVA and Duncan's Multiple Range Test, underscore the need for further investigation into the factors contributing to these seasonal trends, which could have important implications for understanding the environmental impacts on marine life and potential risks to public health.

DISCUSSION

The study of neoplastic growth in fish populations, especially in the context of environmental pollution, has profound implications for both marine ecology and public health (17, 18). As the human population continues to grow, so does the demand for food, including fish, which is a crucial source of low-cholesterol protein for about sixty percent of the world's population (19, 20). This increasing reliance on marine resources makes understanding the health of fish populations more important than ever (21).

Neoplasia, a form of tumor growth, can develop in all teleost fish across the globe. While the exact mechanisms through which normal cells transform into neoplastic cells remain unclear, environmental contamination has been identified as a primary factor (22, 23). Our investigation from January 2019 to December 2022 highlighted significant variations in the incidence of neoplastic growth, with the mean intensity of growth showing significant differences (ANOVA, $F = 13.06$, $P< 0.001$). The least square difference in the number of neoplastic growths was 2.69. This finding is consistent with studies on brown bullhead (1992-1995), where larger fish exhibited a higher propensity for tumors, with the average length of fish with tumors being less than that of fish without tumors (24). In contrast, our study observed that smaller fish were more susceptible to neoplastic growth than larger ones (25, 26).

This susceptibility is further exacerbated by the presence of industrial effluents and domestic sewage in aquatic environments, as evidenced by the work on Mystus gulio, where tumor development and tissue malformations were attributed to industrial waste from sources like Travancore Titanium Products and English clay factories. The presence of tumors in fish in heavily polluted seawaters raises serious concerns about the intricate connections between environmental damage, aquatic life health, and potential impacts on human health.

The accumulation of pollutants and carcinogens in marine ecosystems serves as a stark reminder of the extensive reach of pollution. Ecosystem interconnectivity means that toxins accumulating in fish tissues can ultimately enter the human food chain. Consumption of contaminated fish poses a direct threat to public health, with pollutants and carcinogens potentially causing illnesses in humans (27). This direct linkage underscores the critical need for effective environmental management strategies that prioritize both ecosystem health and public health.

The implications for healthcare and public health are profound. As we grapple with these challenges, it becomes increasingly clear that effective pollution control measures are vital not only for environmental conservation but also for safeguarding human health. By implementing stringent regulations, ecological practices, and collaborative research, we can work towards maintaining healthy oceans, protecting marine life, and ensuring the safety of our food supply. The study's findings highlight the importance of a holistic approach to environmental management, where the health of marine ecosystems is inextricably linked to public health outcomes.

CONCLUSION

The research on neoplastic growth in fish populations, particularly in polluted waters, culminates in crucial implications for environmental conservation and public health. It underscores the urgent need for effective environmental management, highlighting the direct correlation between pollution and marine life health, and its subsequent impact on human health through the food chain. The findings necessitate stringent regulations and robust pollution control measures to mitigate the effects of industrial and domestic waste on marine ecosystems. This study emphasizes the importance of ongoing monitoring and collaborative research to understand and combat the long-term impacts of environmental pollution on marine life. Furthermore, it brings to light the broader implications for food security and public health, given the global reliance on fish as a primary protein source. In conclusion, this research calls for integrated and proactive approaches from policymakers, environmentalists, and health professionals, stressing that the health of our oceans is integrally linked to the health of our people, and addressing environmental pollution is essential to protect marine ecosystems, public health, and sustain vital food resources.

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