FISH CONSUMPTION DIVERSITY AMONG THE ADULT POPULATION OF RURAL BANGLADESH

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ABSTRACT

The fisheries sector occupies a pivotal position in Bangladesh's economy, livelihoods, culture, and nutrition. The current study aimed to explore the diversity in fish consumption and sociodemographic factors associated to fish intake among the Bangladeshi adult rural population. Data from the Bangladesh Integrated Household Survey (BIHS 2018-2019) was used for the current study. Data processing and statistical analysis was done using IBM SPSS version 31.0 and R version 4.5.1. Geometric mean (95% CI) was used to express average fish intake of the respondents and partial proportional odds model was used to explore the factors associated to fish intake among the adult population (age:19-59 years) of rural Bangladesh. Adults (19–59 years) have the highest average fish intake (males 46.47 g/day; females 38.63 g/day), exceeding adolescents (males: 41.04 g/day; females: 35.51 g/day), older adults 60+ (males: 41.75 g/day; females: 34.61 g/day), and children <10 (males: 21.29 g/day; females: 20.40 g/day). About 42 (forty-two) different species of fish consumption was observed among the Bangladeshi rural adults. The overall fish intake comprised 40.77% small indigenous fish species (SIS), 31.35% large indigenous species, 23.67% exotic species, and 4.22% crustaceans. Among adults (19–59 years), fish contributes very little to total energy, negligible to carbohydrates, and a meaningful share to protein (~14%), underscoring its role as a protein-dense rather than energy- or carb-dense food. Sex, household size, division, and marital status were found to be significantly associated with fish intake thresholds ($p < .05$) from partial proportional odds model. These findings highlight the need for targeted nutrition-sensitive policies and equitable food system strategies to enhance access to diverse fish species, ensuring fish continues to play a vital role in improving dietary quality in rural Bangladesh.

KEYWORDS: Fishes, diet, adult, rural population, public health, Bangladesh.

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Introduction

The fisheries sector occupies a pivotal position in Bangladesh's economy, livelihoods, culture, and nutrition, with sustained production growth alongside ecological and management challenges that shape its contribution to food systems. Official and synthesized statistics document substantial expansion in fish production over the last two decades, with aquaculture now contributing the majority share while Inland capture remains significant, yet it faces growing constraints (Chakraborty, 2021; DoF, 2022; Hasan *et al.*, 2020; Hasan *et al.*, 2019). These trends co-exist with sustainability concerns—wetland degradation, habitat fragmentation, pollution, overexploitation, and climate-related stressors—that affect biodiversity, alter species composition, and necessitate conservation and management responses including sanctuaries, breeding ground protection, closed seasons, and hatchery and feed regulation (Chakraborty, 2021; DoF, 2022). Fish is culturally and nutritionally central to Bangladeshi diets and is consumed frequently across rural areas, often daily in season (Roos *et al.*, 2003; Bogard *et al.*, 2017; Akter *et al.*, 2019).

Small indigenous species (SIS) provide dense and bioavailable micronutrients—especially vitamin A, calcium, and iron—when consumed whole, with species like mola contributing substantially to household recommended intakes, and non-farmed fish often delivering higher micronutrient contributions relative to farmed fish (Roos *et al.*, 2003; Bogard *et al.*, 2017). Evidence from the statistics on rural Bangladesh shows fish is the preferred animal-source food and is selected based on taste, price, healthfulness, and availability, with species choices varying by purchasing power and context (Akter *et al.*, 2019). Studies regarding women of reproductive age further link higher fish and animal-source food consumption with improved nutritional status, aligning sectoral production and access with individual-level outcomes (Andrews *et al.*, 2021). Together, these strands position fisheries as a keystone of Bangladesh's food system—integral to economic opportunity and dietary quality—while highlighting the imperative for nutrition-sensitive, biodiversity-conscious management to preserve both production and the micronutrient benefits of diverse fish species (Roos *et al.*, 2003; Bogard *et al.*, 2017; DoF, 2022; Chakraborty, 2021; Hasan *et al.*, 2020; Hasan *et al.*, 2019).

Fish consumption in Bangladesh is widespread yet heterogeneous, with diversity driven by species availability (wild and farmed), affordability and prices, seasonality, ecological conditions, aquaculture participation, market access, and household preferences and norms. Few studies show that rural households consume an array of species—carps, catfishes, small cyprinids, and other SIS—though the relative mix varies by season, location, and income, and is shaped by factors such as taste, perceived health benefits, and price (Akter *et al.*, 2019; Bogard *et al.*, 2017; Roos *et al.*, 2003). Data from some other studies depict that fish species variety in diets reflects both supply-side conditions (production diversity, capture fishery access, hydrological cycles) and demand-side drivers (income, prices, preferences, knowledge), with documented shifts in fish intake over time and across regions (Bogard *et al.*,2017; Thilsted, 2013; DoF, 2022; Chakraborty, 2021).

Moreover, nutrition-oriented analyses highlight how non-farmed and small fish can disproportionately contribute to micronutrient adequacy, implying that losses in capture fisheries biodiversity or restricted access to SIS could reduce diet quality even if total fish volume is maintained through aquaculture (Bogard *et al.*, 2017a; Roos *et al.*, 2003; DoF, 2022). Despite the evident centrality of fish and the recognized nutritional advantages of species-diverse consumption, adult-focused evidence on fish consumption diversity in rural Bangladesh remains limited relative to child or household-focused studies. Andrews *et al.* (2022) investigated the association of fish intake and nutritional status among women of reproductive age in rural Bangladesh. The current study aimed to explore the fish consumption diversity and associated sociodemographic factors among the rural adult population in Bangladesh.

Methodology

Data source

Data utilized in this study came from the third round of the Bangladesh Integrated Household Survey (International Food Policy Research Institute-IFPRI, 2020). BIHS provides precise information on agricultural productivity and practice, dietary consumption and anthropometric information of individual family members, statistics relating to women's empowerment, and is the most thorough and nationally representative household survey in rural Bangladesh.

Sample size

BIHS conducted two-stage stratified sampling technique where 5604 households were included for the third round from rural Bangladesh. Adults (n=11528) ranging in age from 19 to 59 were the primary subjects of this study's analysis as the adult population in rural Bangladesh.

Data collection

BIHS is the only nationally representative survey in Bangladesh that collects detailed data on (1) plot-level agricultural production and practices, (2) dietary intake of individual household members, (3) anthropometric measurements (height and weight) of all household members, and (4) data to measure women's empowerment in agriculture index (WEAI). A community survey supplements the BIHS data to provide information on area-specific contextual factors. The sample is statistically representative at the following levels: (a) nationally representative of rural Bangladesh; and (b) representative of rural areas of each of the seven administrative divisions of the country: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet.

Analysis of dietary data

Adult-male equivalent (AME) approach (Waid *et al.*, 2017) was used to estimate the fish intake of adult individuals in this current study. The dietary data was collected through a single 24-hour recall method, where food weighing was also conducted along with recall technique. The scientific and local names for the fish varieties for whom intake data has been estimated are given below in the following table. The local and scientific names of the forty-two different fish species were obtained from four different sources (Siddiqui and Islam, 2007; Banglapedia; Bangladesh Species Database; BdFISH Feature).

Local names	Scientific names
Rui	*Labeo rohita*
Katla	*Catla catla*
Mrigel	*Cirrhinus cirrhosus*
Kalibaus	*Labeo calbasu*
Chital	*Chitala chitala*
Boal	*Wallago attu*
Aair	*Sperata aor*
Pangash	*Pangasius pangasius*
Hilsa	*Tenualosa ilisha*
Grass Carp	*Ctenopharyngodon idella*
Mirror Carp	*Cyprinus carpio* var. *specularis*
Silver Carp	*Hypophthalmichthys molitrix*
Telapia	*Oreochromis mossambicus*
Swarputi	*Puntius sarana*
Shol	*Channa striata*
Taki	*Channa punctata*
Magur	*Clarias batrachus*

Local names	Scientific names
Shing	*Heteropneustes fossilis*
Bata	*Labeo bata*
Gutum	*Lepidocephalichthys guntea*
Bele	*Glossogobius giuris*
Chewa	*Odontamblyopus rubicundus*
Poa	*Otolithoides pama*
Foli	*Notopterus notopterus*
Baim	*Mastacembelus armatus*
Koi	*Anabas cobojius*
Bagda Chingri	*Penaeus monodon*
Golda Chingri	*Macrobrachium rosenbergii*
Puti	*Puntius sophore*
Tengra	*Mystus tengara*
Pabda	*Ompok pabda*
Mola	*Amblypharyngodon mola*
Dhela	*Osteobrama cotio*
Kachki	*Corica soborna*
Chanda	*Chanda nama*
Khalisa	*Trichogaster fasciata*
Chela	*Chela cachius*
Chapila	*Gudusia chapra*
Tatkini	*Cirrhinus reba*
Parshe	*Chelon parsia*
Common carp	*Cyprinus carpio*
Small prawn	*Macrobrachium lamarrei*

Fish nutrient values and edible portion coefficients were obtained mainly from Food Composition Tables for Bangladesh (BFCT) (Shaheen *et al.*, 2013). However, Indian Food Composition Tables and other published literature (Ahmed *et al.*, 2019a, 2019b, 2024; Miah *et al.*, 2025) were also considered for nutrient values.

Statistical analysis

All statistical analysis was done using R 4.5.1. Geometric mean (95% CI) was used to express average fish intake of the respondents since the data distribution of fish intake variable was skewed, and partial proportional odds model was used to explore the sociodemographic factors associated to fish intake among the adult population of rural Bangladesh. We categorized fish intake into quartiles to form a four-level ordinal outcome and estimated a partial proportional odds cumulative logit model with three thresholds (K−1) (McCullagh, P., 1980; Peterson & Harrell, 1990).

Ethical approval

After reviewing, the Bangladeshi Ministry of Agriculture gave the go-ahead for the BIHS 2018-2019. Participants gave their verbal consent to take part in the survey. Ethical permission was not required to access the publicly available database used for the current study. The information regarding the exact GPS Coordinates of the surveyed households, names, and mobile numbers of the household heads was not available in the publicly available dataset to protect household and individual-level data confidentiality.

Results

Table 1 presents the average daily fish consumption (in grams) among different age groups and sexes in the rural population of Bangladesh, along with their respective 95% confidence intervals (C.I.). Fish consumption was lowest among children under 10 years. Consumption increased markedly in the 10 to 18-year age group, reaching 41.04 g/day for males and 35.51 g/day for females. The highest intake was observed among adults aged 19 to 59 years, with males consuming 46.47 g/day and females 38.63 g/day. In the oldest age group (60 years and above), fish consumption declined slightly to 41.75 g/day for males and 34.61 g/day for females. Across all age groups, males consistently consumed more fish than females.

Table 1. Fish consumption among different age groups in the rural population of Bangladesh

Respondents (Age in years)	Sex	Overall Fish Consumption[a] (g)	Lower C.I.	Upper C.I.
Less than 10	Male	21.29	20.39	22.24
	Female	20.40	19.51	21.34
10 to 18	Male	41.04	39.34	42.83
	Female	35.51	34.00	37.08

19 to 59	Male	46.47	45.11	47.87
	Female	38.63	37.63	39.65
60 and above	Male	41.75	39.23	44.43
	Female	34.61	32.39	36.97

a: Geometric mean; C.I.: Confidence Interval,

Figure 1 displays the average daily fish intake across four age groups in the rural population of Bangladesh. Intake is lowest among children under 10 years, increases through adolescence (10–18 years), and peaks in adulthood (19–59 years), followed by a modest decline among those aged 60 years and older. The monotonic rise from childhood to mid-adulthood suggests increasing dietary incorporation of fish with age, consistent with greater caloric needs and autonomy in food choices. The slight reduction in the oldest age group may reflect changes in appetite, dentition, comorbidities, or access. Fish intake was found statistically significant ($p<.05$) among different age groups, using the Kruskal-Wallis test.

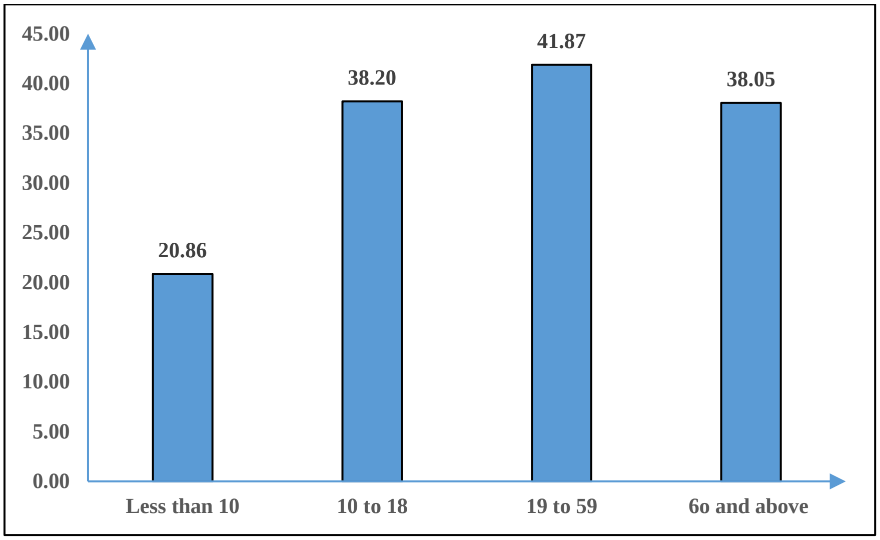

Figure 1. Average fish consumption (in g) among different age groups ($p<.05$).

Figure 2 shows the contribution of different types of fish to overall fish intake among the respondents. Overall fish intake was predominantly composed of indigenous species, with Small Indigenous Species (SIS) contributing 40.77% and Large Indigenous Species (LIS) contributing 31.35% of total consumption. Exotic species accounted for 23.67%, while crustaceans represented a minor share at 4.22%. These proportions indicate a strong reliance on native fish—particularly SIS—as the primary component of fish-based diets in rural settings, with exotic species playing a secondary role and crustaceans contributing minimally.

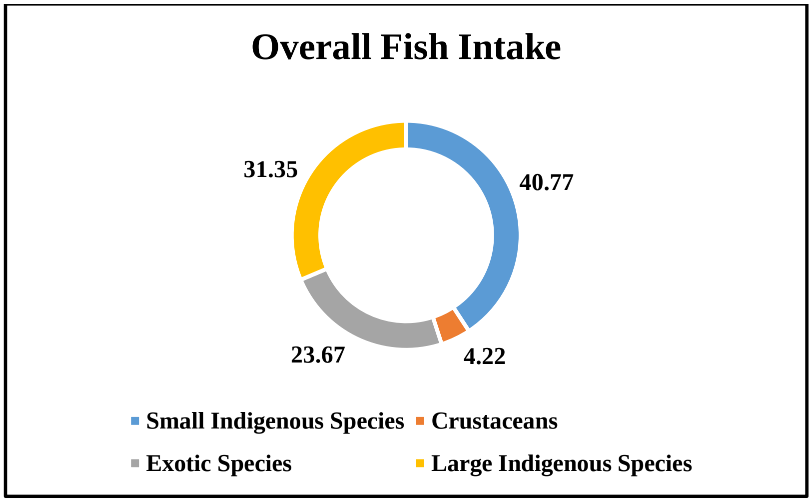

Figure 2. Contribution of different types of fish to overall fish intake among the respondents

Table 2 shows the species-specific average daily fish intake in grams, stratified by sex, with accompanying 95% confidence intervals, enabling direct comparison between men and women for each species. For Rui, the average intake is higher among men at 45.85 g (95% CI: 42.40, 49.59) compared with women at 39.42 g (36.84, 42.17). Baim shows a similar pattern with men consuming 35.71 g (22.33, 57.10) and women 31.03 g (20.74, 46.41). In contrast, Katla intake is slightly higher among women at 33.66 g (27.90, 40.62) than men at 31.18 g (25.70, 37.82). For Koi, men consume 31.99 g (27.40, 37.34), exceeding women at 25.65 g (22.35, 29.42). Mrigel also shows higher intake among men at 40.08 g (34.16, 47.03) relative to women at 32.07 g (27.98, 36.75). Bagda Chingri demonstrates elevated intake in both sexes with men at 47.09 g (26.12, 84.90) and women at 42.08 g (22.21, 79.71), although the wide confidence intervals indicate substantial variability or limited precision. Across these species, men generally report higher intake than women, though species-specific exceptions (e.g., Katla) are evident. The widths of the confidence intervals differ notably by species, with narrower intervals (e.g., Koi, Rui) suggesting more precise estimates and wider intervals (e.g., Bagda Chingri) indicating greater uncertainty, potentially due to smaller consumption percentage or heterogeneous consumption patterns. The table conveys species-level differences in average daily fish intake by sex, with a general tendency toward higher male consumption but meaningful variation by species.

Table 2. Fish consumption diversity among the rural adult population in Bangladesh

Fish	Sex	Dietary Intake (g)	Fish	Sex	Dietary Intake (g)
Small Indigenous Species (SIS)					
Swarputi (1.3) *Puntius sarana*	M	41.08 (36.01,46.88)	Baim (0.5) *Mastacembelus armatus*	M	35.71 (22.33,57.10)
	F	32.91 (28.98,37.38)		F	31.03 (20.74,46.41)
Taki (3.3) *Channa punctata*	M	48.86 (43.38,55.03)	Koi (2.1) *Anabas cobojius*	M	31.99 (27.40,37.34)
	F	40.10 (35.78,44.93)		F	25.65 (22.35,29.42)
Magur (0.4) *Clarias batrachus*	M	45.34 (30.56,67.25)	Puti (2.5) *Puntius sophore*	M	39.45 (33.55,46.38)
	F	48.30 (35.14,66.39)		F	33.26 (28.21,39.21)
Shing (1.7) *Heteropneustes fossilis*	M	39.39 (33.40,46.46)	Tengra (2.3) *Mystus tengara*	M	46.69 (40.70,53.56)
	F	28.69 (24.57,33.50)		F	40.14 (35.87,44.91)
Bata (2.8) *Labeo bata*	M	46.71 (41.30,52.83)	Pabda (0.1) *Ompok pabda*	M	25.31 (12.86,49.81)
	F	41.50 (36.71,46.91)		F	26.94 (19.86,36.55)
Gutum (0.1) *Lepidocephalichthys guntea*	M	36.99 (15.98,85.60)	Mola (0.6) *Amblypharyngodon mola*	M	38.10 (28.29,51.31)
	F	29.58 (16.16,54.17)		F	31.63 (24.15,41.42)
Bele (0.3) *Glossogobius giuris*	M	45.21 (30.34,67.38)	Dhela (0.1) *Osteobrama cotio*	M	39.43 (18.10,85.89)
	F	33.09 (23.14,47.33)		F	37.20 (24.31,56.91)
Chewa (0.8) *Odontamblyopus rubicundus*	M	26.73 (19.45,36.72)	Kachki (0.4) *Corica soborna*	M	53.21 (29.74,95.19)
	F	28.92 (23.49,35.60)		F	54.21 (36.20,81.17)
Poa (1.4) *Otolithoides pama*	M	32.10 (25.70,40.10)	Chanda (0.1) *Chanda nama*	M	46.05 (23.36,90.79)
	F	26.40 (22.13,31.48)		F	36.26 (21.46,61.26)
Foli (0.3) *Notopterus notopterus*	M	19.34 (10.41,35.93)	Khalisa (0.7) *Trichogaster fasciata*	M	17.06 (12.15,23.96)
	F	18.45 (10.80,31.49)		F	15.53 (11.67,20.66)
Chela (0.2) *Chela cachius*	M	18.33 (5.74,58.59)	Chapila (0.7) *Gudusia chapra*	M	57.34 (46.02,71.44)
	F	14.02 (5.49,35.77)		F	55.61 (45.91,67.36)
Tatkini (0.1) *Cirrhinus reba*	M	21.52 (6.97,66.38)	Parshe (0.7) *Chelon parsia*	M	51.65 (32.59,81.86)
	F	15.34 (6.85,34.37)		F	53.24 (35.79,79.21)
Dried small fish (16.3)	M	8.11 (7.67,8.57)	Panch mishali (3.3)	M	60.28 (53.19,68.31)
	F	6.82 (6.50,7.16)		F	46.98 (42.09,52.44)
Poona fish (1.4)	M	40.52 (34.28,47.90)	Gura (2.5)	M	31.58 (26.48,37.66)
	F	32.11 (27.84,37.03)		F	31.32 (27.00,36.34)
Crustaceans					
Bagda Chingri (0.2) *Penaeus monodon*	M	47.09 (26.12,84.90)	Golda Chingri (0.2) *Macrobrachium rosenbergii*	M	71.73 (54.76,93.95)
	F	42.08 (22.21,79.71)		F	56.18 (46.17,68.37)
Small prawn (4.3) *Macrobrachium lamarrei*	M	23.63 (20.64,27.05)	Dried small shrimp (1.3)	M	6.91 (5.44,8.79)
	F	20.21 (18.04,22.64)		F	6.31 (5.09,7.83)
Exotic species					

Fish	Sex	Dietary Intake (g)	Fish	Sex	Dietary Intake (g)
Common carp (1.6) *Cyprinus carpio*	M	36.34 (29.30,45.09)	Grass Carp (0.6) *Ctenopharyngodon idella*	M	39.06 (29.63,51.48)
	F	29.92 (24.90,35.95)		F	34.23 (26.72,43.84)
Mirror Carp (1.3) *Cyprinus carpio* var. *specularis*	M	43.45 (36.28,52.03)			
	F	35.43 (30.42,41.27)	Silver Carp (7.6) *Hypophthalmichthys molitrix*	M	50.99 (47.28,54.98)
Telapia (12.8) *Oreochromis mossambicus*	M	26.07 (24.40,27.86)		F	42.78 (40.00,45.77)
	F	22.97 (21.67,24.36)			
Large Indigenous Species					
Rui (8.6) *Labeo rohita*	M	45.85 (42.40, 49.59)	Katla (1.1) *Catla catla*	M	31.18 (25.70,37.82)
	F	39.42 (36.84, 42.17)		F	33.66 (27.90,40.62)
Mrigel (2.1) *Cirrhinus cirrhosus*	M	40.08 (34.16,47.03)	Kalibaus (0.4) *Labeo calbasu*	M	58.21 (43.67,77.59)
	F	32.07 (27.98,36.75)		F	34.91 (27.50,44.32)
Chital (0.1) *Chitala chitala*	M	33.63 (19.97,56.62)	Boal (0.3) *Wallago attu*	M	25.70 (15.39,42.93)
	F	35.60 (22.86,55.44)		F	19.31 (13.24,28.17)
Aair (0.1) *Sperata aor*	M	64.60 (33.19,125.75)	Pangash (6.9) *Pangasius pangasius*	M	37.20 (34.66,39.93)
	F	57.44 (34.74,94.99)		F	31.07 (29.11,33.15)
Hilsa (2.8) *Tenualosa ilisha*	M	42.91 (37.30,49.35)	Shol (1.6) *Channa striata*	M	49.56 (42.79,57.41)
	F	37.05 (32.82,41.82)		F	39.61 (34.23,45.83)
Jatka (2.3)	M	52.20 (45.64,59.71)	Dried fish (2.0)	M	11.37 (9.61,13.45)
	F	44.22 (39.04,50.08)		F	8.56 (7.33,9.99)

N.B.: Values within bracket beside the fish names denote the consumption percentage of that particular fish species among the respondents; M=Male adult respondent, F=Female adult respondent; the values in dietary intake columns are provided as geometric mean (95% C.I.)

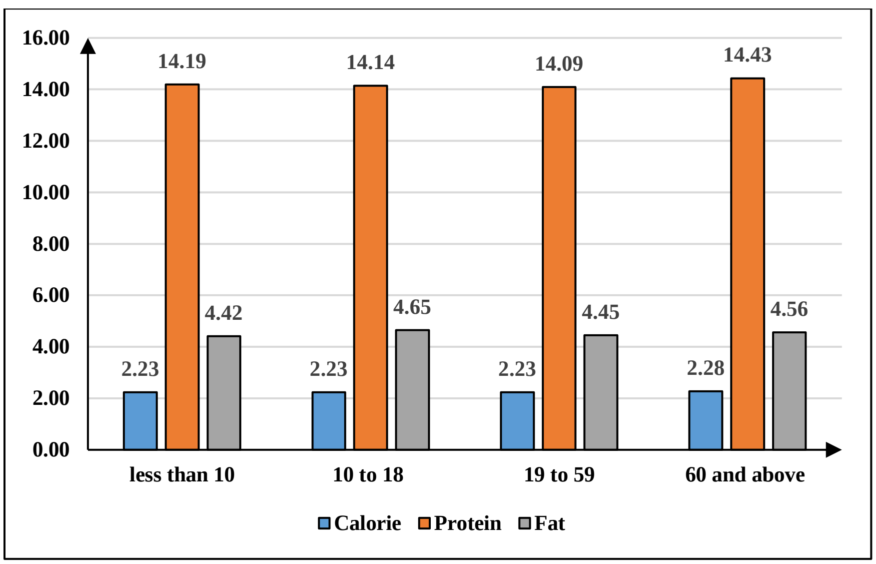

Figure 3. Percent contribution of fish to calorie, protein and fat intake among different age groups (p>.05)

The figure 3 depict the percent contribution of fish to total calorie, protein, and fat intake across four age categories: less than 10 years, 10–18 years, 19–59 years, and 60 years and above. The y-axis expresses percentage contribution (0–16%), while the x-axis lists age groups. Within each age group, three bars represent macronutrient contributions: calorie (blue), protein (orange), and fat (gray). The chart shows a consistent pattern in which fish contributes substantially to protein intake across all ages (approximately 14.1–14.4%), with the highest contribution in individuals aged ≥60 years (around 14.43%) and the lowest in adults aged 19–59 years (around 14.09%). In contrast, the contribution of fish to total calorie intake is uniformly low and stable (roughly 2.23–2.28%) across all age groups. The contribution to total fat intake is modest (approximately 4.42–4.65%), peaking in the 10–18-year group (about 4.65%). Although slight differences was observed among different age groups, the differences were not statistically significant (p>.05). P-values were obtained using the Kruskal-Wallis test.

Table 3 shows the association between sex (reference = female) and ordered fish intake categories. Sex showed threshold-specific effects: at $P(Y \leq 2)$, males had significantly lower odds of being at or below category 2 compared to females; at $P(Y \leq 3)$, males also had lower odds of being at or below category 3. The effect at $P(Y \leq 1)$ was not significant (OR = 0.98, 95% CI [0.90, 1.07], p = .696). These findings indicate that men are more likely than women to fall into higher fish intake categories, particularly beyond the second category. Compared to women, men tend to be in higher fish intake groups. The difference is small at the very lowest vs. the next category, but becomes clear and statistically reliable when comparing across the middle and higher thresholds. In case of age, at the first threshold ($P(Y \leq 1)$), each one-year increase in age was associated with a statistically significant 0.6% increase in the odds of being in the lowest fish intake category versus higher categories. The effect at the second threshold approached significance, while the effect at the third threshold was not significant. These findings indicate that older adults have slightly higher odds of being in the lowest fish intake category compared to younger adults. Age has a small but meaningful effect on fish consumption patterns. Specifically, older people are slightly more likely to be in the lowest fish intake group compared to all higher intake groups. This age effect is most pronounced when comparing the very lowest intake level to everything else, but becomes weaker and non-significant when looking at higher intake thresholds. In practical terms, for every additional year of age, there's about a 0.6% increase in the likelihood of being in the lowest fish consumption category.

On the other hand, Muslims had significantly lower odds of being at or below the first threshold compared to those following Hinduism, and lower odds at the second threshold. The effect at the third threshold was not significant. For other religions, effects were not statistically significant. These findings indicate that, relative to Hindus, Muslims are less likely to be in lower fish intake categories, particularly at the lower thresholds. Each additional household member was associated with significantly lower odds of being in the lowest category versus higher categories ($P(Y \leq 1)$). The effect at the second threshold was not statistically significant ($P(Y \leq 2)$). At the third threshold, each additional household member was associated with higher odds of being in categories 1–3 versus the highest category ($P(Y \leq 3)$). These results indicate that larger households are less likely to be at the very lowest level of fish intake, but are also less likely to be in the very highest intake category. Compared with Sylhet division, Barisal exhibited significantly higher odds of being in the lowest fish intake category versus higher categories ($P(Y \leq 1)$), with no significant differences observed at $P(Y \leq 2)$ or $P(Y \leq 3)$. Chittagong showed significantly higher odds of being in categories 1–3 versus the highest category ($P(Y \leq 3)$), with non-significant effects at lower thresholds. These findings suggest meaningful geographic (division-level) variation in fish intake relative to Sylhet, particularly at the lower and upper ends of the distribution. Overall, fish intake varied by division, with differences that are most pronounced at the extremes (lowest vs. highest intake).

However, in case of association between decision making and fish intake, effects were not statistically significant across thresholds. These results indicate no meaningful differences in fish intake categories by household decision-maker. Partial-proportional odds model assessed the association between the number of women aged 15–49 in the household and ordered fish intake categories. The number of women showed threshold-specific effects. Each additional woman was associated with significantly lower odds of being in the lowest intake category versus higher categories ($P(Y \leq 1)$).

Table 3. Sociodemographic factors associated with fish intake among the rural adult population (using Partial-Proportional Odds Model)

Independent variable (s)		**P (Y ≤ 1)**				**P (Y ≤ 2)**				**P (Y ≤ 3)**			
		COR	**95% C.I.**		**p-value**	**COR**	**95% C.I.**		**p-value**	**COR**	**95% C.I.**		**p-value**
			Lower	**Upper**			**Lower**	**Upper**			**Lower**	**Upper**	
Sex	**Male**	0.980	0.90	1.07	>.05	0.79	0.74	0.85	<.05	0.67	0.62	0.73	**<.05**
	Female	*Reference category*											
Age		1.006	1.002	1.009	<.05	1.003	1	1.006	>.05	0.999	0.995	1.003	>.05
Religion	**Muslim**	0.538	0.477	0.606	<.05	0.775	0.692	0.867	<.05	1.05	0.923	1.194	>.05
	Others	1.997	0.989	4.034	>.05	1.169	0.573	2.386	>.05	0.765	0.359	1.631	>.05
	Hindu	*Reference category*											
HH size		0.875	0.855	0.896	<.05	0.987	0.969	1.005	>.05	1.069	1.045	1.093	**<.05**
Division	**Barisal**	1.539	1.258	1.881	<.05	1.088	0.923	1.283	>.05	1.179	0.986	1.409	>.05
	Chittagong	1.045	0.881	1.239	>.05	1.064	0.935	1.211	>.05	1.348	1.171	1.553	<.05
	Dhaka	1.241	1.069	1.442	<.05	1.244	1.109	1.397	<.05	1.549	1.365	1.758	**<.05**
	Khulna	1.388	1.153	1.67	<.05	1.004	0.866	1.165	>.05	1.027	0.877	1.202	>.05
	Rajshahi	3.544	3.003	4.183	<.05	2.227	1.924	2.578	<.05	2.327	1.953	2.772	**<.05**
	Rangpur	5.128	4.323	6.084	<.05	3.716	3.156	4.375	<.05	3.06	2.509	3.732	**<.05**
	Sylhet	*Reference category*											
Decision maker		0.906	0.799	1.027	>.05	0.998	0.894	1.115	>.05	1.077	0.95	1.221	>.05
No. of women (15 to 49 years old)		0.757	0.713	0.803	<.05	0.959	0.914	1.006	>.05	1.083	1.024	1.146	**<.05**
No. of child (under 6 years old)		0.812	0.767	0.86	<.05	0.95	0.906	0.995	<.05	1.104	1.045	1.167	**<.05**

Marital status	**Unmarried**	0.809	0.701	0.933	<.05	0.84	0.747	0.946	<.05	0.783	0.687	0.891	<.05
	Widow/widower	1.273	1.05	1.544	<.05	1.359	1.137	1.623	<.05	1.297	1.043	1.613	<.05
	Divorced	1.151	0.748	1.771	>.05	1.309	0.887	1.934	>.05	1.226	0.764	1.967	>.05
	Separated	1.132	0.725	1.767	>.05	1.176	0.789	1.754	>.05	1.283	0.783	2.101	>.05
	Married	*Reference category*											

The effect at the second threshold was not statistically significant ($P(Y \leq 2)$). Conversely, each additional woman was associated with higher odds of being in categories 1–3 versus the highest category ($P(Y \leq 3)$). These findings suggest that households with more women of reproductive age are less likely to be at the very lowest level of fish intake but also less likely to be at the very highest level. More women aged 15–49 in a household is linked to avoiding the very lowest fish intake level. However, households with more women are also less likely to reach the very highest intake level, tending to fall somewhere in the middle of the distribution. The number of young children showed threshold-specific effects. Each additional child under 6 was associated with lower odds of being in the lowest fish intake category versus higher categories ($P(Y \leq 1)$ and a modest reduction at the second threshold ($P(Y \leq 2)$). Conversely, each additional child under 6 was associated with higher odds of being in categories 1–3 versus the highest category ($P(Y \leq 3)$). These findings suggest that households with more young children are less likely to be at the very lowest level of fish intake but also less likely to reach the very highest level. More young children in the household are linked to avoiding the very lowest fish intake group. However, households with more young children are also less likely to be in the very highest fish intake group; they tend to fall in the middle. In case of marital status, unmarried adults showed significantly lower odds of being at or below each threshold relative to married ($P(Y \leq 1)$, indicating greater likelihood of higher intake levels.

Discussion

In the current study, it was found that average fish consumption was 46.47 g/day for male and 38.63 g/day for female rural adult respondents of Bangladesh. Some ranges of confidence intervals were found to be wide, suggesting high variation in fish intake among the respondents. Overall, the value was found to be 41.87 g/day irrespective of sex. In case of contribution of different fish types to total fish intake, we observed that 40.77% were comprised of SIS, 4.22% were crustaceans, 23.67% were exotic species, and 31.35% were large indigenous species. Across all age groups, males consistently consumed more fish than females. The gender gap in fish consumption was most pronounced in the 19 to 59-year age group. These findings highlight both age- and sex-related differences in fish consumption patterns in rural Bangladesh, with adult males having the highest intake and young children the lowest. The observed trends may reflect differences in dietary needs, cultural practices, and intra-household food allocation. The monotonic rise from childhood to mid-adulthood suggests increasing dietary incorporation of fish with age, consistent with greater caloric needs and autonomy in food choices. The slight reduction in the oldest age group may reflect changes in appetite, dentition, comorbidities, or access. Major commonly consumed SIS were dried small fish (called 'Shutki' in local Bengali language) (16.3%), Taki (3.3%), Panch mishali (3.3%), Bata (2.8%), Puti (2.5%) and Mola (0.6%). Among the large indigenous species, the most commonly consumed were Rui (8.6%), Pangash (6.9%), Hilsha (2.8%), and Mrigel (2.1%). On the other hand, Tilapia (12.8%) and silver carp (7.6%) were found to be the most commonly consumed exotic species (carps), and Small prawns (called 'Gura icha' in the local Bengali language) (4.3%) were the most commonly consumed crustaceans among the respondents. The percentage contribution of fish to total protein intake among rural adult individual was about 14.09%, to total fat intake was about 4.45% and total calorie intake was about 2.23%. Sex, household size, division, and marital status were found to be significantly associated with fish intake thresholds ($p < .05$) from partial proportional odds model.

Data regarding nutritional status of adults were found in Bangladesh Demographic and Health Survey 2022 report, but their food consumption or fish intake was not available (NIPORT, 2024). However, children's diet or feeding practices were found in the report. On the other hand, although not age-specific, but rural fish intake (mean) data were found to be 60.6 g/day in 2016 and 68.20 g/day in 2022 in the final report of Household Income and Expenditure Survey 2022 (BBS, 2023). The percentage contribution of fish to total calorie and protein intake were 3.54% and 3.4% in 2016, and 17.71% and 17% in 2022, respectively. Nguyen *et al.* (2025) reported that the percent contribution of meat, poultry, and fish to total calorie intake was about 3.1% in 2011 and 2.9% in 2018. Ahmed *et al.*, in their study in 2022, showed that reported that overall fish intake was 47g/day, against the 60 g recommended amount for Bangladeshi people as desirable intake, fish consumption diversity was not shown in the above-mentioned study (Nahar *et al.*, 2013). However, the report by Nahar *et al.* (2013) showed that mean fish intake was 50.3 g/day for Bangladesh people. In the case of fish intake diversity, they showed that Rui/Katla/Mrigel/Kalibaush intake was about 7.50 g/day, Silver carp/Grass carp/Miror carp intake was 5.96 g/day, Hilsa intake was 3.43 g/day and dried fish intake was about 0.96 g/day. Different types of fish consumption among women and children in two districts of Bangladesh was reported in a preprint by Njogu *et al.*, (2022). The consumption percentage of Rui, Carp, and Puti was 15%, 14%, and 7%, respectively. They also analyzed some determinants of fish consumption among the respondents (such as location, land ownership, education, price etc.), and we found an association between fish intake and sex, household size, division, marital status etc. Small fish consumption was found very low in the study, just as we found in our study that the consumption percentage was low for SIS. Another study by Rahman and Islam (2020) involved factors associated to fish intake among 128 samples in the Rangpur region of Bangladesh. They found a positive association between fish consumption and education, along with income; a negative association between age and fish intake. Thilsted (2013) mentioned that the intake of SIS comprised two-thirds of total fish intake, but species-level intake was not found in the study. We showed species-level fish intake data in the current study, and showed that SIS contributed about 40.77% of total fish intake. Roos *et al.* (2003) analyzed the contribution of small fish to dietary vitamin A, calcium, and iron intake. We did not show the contribution of fish to micronutrient intake in our study; rather, we analyzed the contribution of fish to calorie, protein, and fat intake. The study by Hasan *et al.* (2019) conducted a trend analysis of food intake from 1961-2013, using FAO's food balance sheets. On the contrary, we did not conduct trend analysis in our current study and showed a cross-sectional picture of the rural adults' fish intake diversity. Roos *et al.* (2002) analyzed the vitamin A content of 26 fish species by HPLC method. They showed that SIS can be a good source of dietary vitamin A to reduce vitamin A deficiency. Akter *et al.* (2019) also depicted that fish is the preferred animal food in rural community of Bangladesh, and hence, it should be prioritized in dietary intervention programs for improved food and nutrition security. Limitations of the current study include cross-sectional nature of the survey, a single 24-hour recall method was used to collect dietary data in BIHS. However, a weighing method was also conducted to enhance the accuracy of dietary recall data. On the other hand, seasonal variation and fish price data were not considered in the analysis for the current study.

Conclusion

Fish consumption among Bangladeshi rural adults did not meet the desirable limit (60 g) for the Bangladeshi population. About 42 fish species were observed in the diet of rural adults in Bangladesh, with intake dominated by indigenous fish—40.77% small indigenous species and 31.35% large indigenous species—alongside 23.67% exotic species and 4.22% crustaceans. These findings support nutrition-sensitive, equity-focused food system strategies to expand access to diverse fish, particularly indigenous species, to sustain and enhance dietary quality in rural Bangladesh

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