**Fish consumption and the risk of cardiovascular disease and mortality in patients with type 2 diabetes: a dose-response meta-analysis of prospective cohort studies**

Ahmad Jayedi1, Sepideh Soltani2, Anna abdoshahi1, Sakineh Shab-Bidar3

1Food Safety Research Center (salt), Semnan University of Medical Sciences, Semnan, Iran

2[Yazd Cardiovascular Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran](https://www.scirp.org/Journal/articles.aspx?searchCode=Yazd+Cardiovascular+Research+Center%2c+Shahid+Sadoughi+University+of+Medical+Sciences%2c+Yazd%2c+Iran&searchField=affs&page=1).

3Department of Community Nutrition, School of Nutritional Science and Dietetics, Tehran University of Medical Sciences, Tehran, Iran

***Running title:*** Fish and CVD and mortality in diabetic patients

**\*Corresponding author:** Sakineh Shab-Bidar, **Associate Professor, Department of Community Nutrition, School of Nutritional Sciences and Dietetics, Tehran University of Medical Sciences, P. O. Box 14155/6117, Tehran, Iran Telefax: +98(21)88955979, Email:**[s\_shabbidar@tums.ac.ir](mailto:s_shabbidar@tums.ac.ir)

**Supplementary Table 1**.Reported risk estimates in the primary studies in meta-analysis of fish consumption and the risk of cardiovascular disease and mortality in patients with type 2 diabetes.

|  |  |  |
| --- | --- | --- |
| **Fish intake categories** | **Number of cases/ participants (personyears)** | **Relative risk (95%CI)** |
| Deng, 2018 (USA)  National Health and Nutrition Examination Survey, 1988-1994  All-cause mortality | | |
| <1 time/week | 312/481 | 1.00 |
| 1-2 times/week | 248/413 | 0.90 (0.75-1.08) |
| ≥2 times/week | 138/242 | 0.83 (0.67-1.03) |
| Deng, 2018 (USA)  National Health and Nutrition Examination Survey, 1988-1994  Stroke mortality | | |
| <1 time/week | 29/481 | 1.00 |
| 1-2 times/week | 16/413 | 0.55 (0.28-1.07) |
| ≥2 times/week | 6/242 | 0.30 (0.11-0.80) |
| Deng, 2018 (USA)  National Health and Nutrition Examination Survey, 1988-1994  Heart disease mortality | | |
| <1 time/week | 131/481 | 1.00 |
| 1-2 times/week | 94/413 | 0.83 (0.62-1.11) |
| ≥2 times/week | 50/242 | 0.79 (0.56-1.12) |
| Feskens, 1993 (Netherlands)  Coronary heart disease mortality | | |
| Non-fish consumers | 10/32 | 1.00 |
| Fish consumers | 11/51 | 0.66 (0.33-1.84) |
| Hu, 2003 (USA)  Nurses’ Health Study  Coronary heart disease incidence | | |
| <1/month | 41/3170 | 1.00 |
| 1-3 month | 92/11685 | 0.70 (0.48-1.03) |
| 1/week | 161/21705 | 0.60 (0.42-0.85) |
| 2-4 week | 52/6495 | 0.64 (0.42-0.99) |
| >5 week | 16/2790 | 0.36 (0.20-0.66) |
| Hu, 2003 (USA)  Nurses’ Health Study  All-cause mortality | | |
| <1/month | 48/3209 | 1.00 |
| 1-3 month | 114/11784 | 0.75 (0.53-1.07) |
| 1/week | 219/21837 | 0.66 (0.48-0.92) |
| 2-4 week | 60/6554 | 0.67 (0.45-1.01) |
| >5 week | 27/2808 | 0.48 (0.29-0.80) |
| Iimuro, 2011 (Japan)  J-EDIT study  All-cause mortality | | |
| Low intake | - | 1.00 |
| Middle intake | - | 0.72 (0.40-1.31) |
| High intake | - | 0.82 (0.46-1.47) |
| Strand, 2013 (Norway)  Western Norway B-Vitamin Intervention Trial  Myocardial infarction | | |
| Tertile 1 | - | 1.00 |
| Tertile 2 | - | 0.94 (0.45-1.98) |
| Tertile 3 | - | 0.66 (0.29-1.53) |
| Trichopoulou, 2006 (Greece)  European Prospective Investigation into Cancer and Nutrition (EPIC).  All-cause mortality | | |
| Fish and seafood | Standard deviation increase | 1.02 (0.80-1.30) |
| Villegas, 2015 (USA)  Southern Community Cohort Study  All-cause mortality | | |
| Quintile 1 | - | 1.00 |
| Quintile 2 | - | 0.98 (0.86-1.12) |
| Quintile 3 | - | 0.91 (0.79-1.04) |
| Quintile 4 | - | 0.99 (0.87-1.13) |
| Quintile 5 | - | 0.89 (0.77-1.03) |
| Wallin, 2017 (Sweden)  Swedish Mammography Cohort and the Cohort of Swedish Men  All-cause mortality | | |
| 0.5 serving/week (median) | 92/2950 | 1.00 |
| 1.4 servings/week | 292/12218 | 0.82 (0.64-1.04) |
| 2.4 servings/week | 232/9597 | 0.79 (0.61-1.01) |
| 3.5 servings/week | 155/4670 | 0.90 (0.69-1.18) |
| Wallin, 2017 (Sweden)  Swedish Mammography Cohort and the Cohort of Swedish Men  Coronary heart disease mortality | | |
| 0.5 serving/week (median) | 22/2950 | 1.00 |
| 1.4 servings/week | 49/12218 | 0.53 (0.32-0.90) |
| 2.4 servings/week | 54/9597 | 0.75 (0.45-1.27) |
| 0.3.5 servings/week | 29/4670 | 0.77 (0.43-1.40) |
| Wallin, 2017 (Sweden)  Swedish Mammography Cohort and the Cohort of Swedish Men  Stroke | | |
| 0.5 serving/week (median) | 31/2569 | 1.00 |
| 1.4 servings/week | 135/10913 | 1.02 (0.68-1.51) |
| 2.4 servings/week | 94/8548 | 0.89 (0.58-1.35) |
| 0.3.5 servings/week | 61/4157 | 1.04 (0.66-1.64) |
| Wallin, 2017 (Sweden)  Swedish Mammography Cohort and the Cohort of Swedish Men  Myocardial infarction | | |
| 0.5 serving/week (median) | 48/2569 | 1.00 |
| 1.4 servings/week | 130/10913 | 0.66 (0.47-0.92) |
| 2.4 servings/week | 107/8548 | 0.67 (0.47-0.96) |
| 0.3.5 servings/week | 48/4157 | 0.60 (0.39-0.92) |
| Zhang, 2018 (USA)  NIH-AARP Diet and Health Study  All-cause mortality (Men) | | |
| Quintile 1 | - | 1.00 |
| Quintile 2 | - | 0.95 (0.89-1.02) |
| Quintile 3 | - | 0.98 (0.91-1.05) |
| Quintile 4 | - | 0.96 (0.89-1.03) |
| Quintile 5 | - | 0.93 (0.86-1.00) |
| Zhang, 2018 (USA)  NIH-AARP Diet and Health Study  All-cause mortality (Women) | | |
| Quintile 1 | - | 1.00 |
| Quintile 2 | - | 0.96 (0.86-1.07) |
| Quintile 3 | - | 1.02 (0.92-1.14) |
| Quintile 4 | - | 1.02 (0.91-1.13) |
| Quintile 5 | - | 1.01 (0.91-1.13) |
|  |  |  |

**Supplementary Table 2.** Scoring for the different components of NutriGrade for each outcome.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome | Risk of bias | Precision | Heterogeneity | Directness | Publication bias | Funding bias | Effect size | Dose-response | Sum | NutriGrade |
| All-cause mortality | 1 | 1 | 0.5 | 1 | 0.5 | 1 | 0 | 1 | 6 | Moderate |
| Coronary heart disease | 1 | 0 | 0.2 | 1 | 0 | 1 | 1 | 1 | 5.2 | Low |
| Stroke | 1 | 0 | 0.2 | 1 | 0 | 1 | 0 | 0 | 3.2 | Very low |
| Myocardial infarction | 1 | 0 | 0.2 | 1 | 0 | 1 | 0 | 0 | 3.2 | Very low |

D:\Meta\Fish and T2D\Figurs\Supp Figure 1.tif

**Supplementary Figure 1.** Funnel plot of the relative risks of 8 studies on fish intake and the risk of cardiovascular disease and mortality in patients with type 2 diabetes. Begg’s test, *P*=0.26, Egger’s test, *P*=0.08. Log RR: natural logarithm of relative risk. s.e: standard error.

J:\Fish and T2D\Figurs\Supp Figure 2.tif

**Supplementary Figure 2.** Relative risk of coronary heart disease for the highest compared to the lowest category of fish intake.

J:\Fish and T2D\Figurs\Supp Figure 3.tif

**Supplementary Figure 3.** Relative risks of myocardial infarction and stroke for the highest compared to the lowest category of fish intake.

PRISMA checklist

|  |  |  |  |
| --- | --- | --- | --- |
| **Section/topic** | **#** | **Checklist item** | **Reported on page #** |
| **TITLE** | | |  |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | Title page |
| **ABSTRACT** | | |  |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 2 |
| **INTRODUCTION** | | |  |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 3 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 4 |
| **METHODS** | | |  |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | - |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 4,5 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 4 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | 4,5 |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 7, Fig 1 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 5,6 |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 6, 7 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 6,7 |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 6,7 |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis. | 6,7 |

Page 1 of 2

|  |  |  |  |
| --- | --- | --- | --- |
| **Section/topic** | **#** | **Checklist item** | **Reported on page #** |
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | 6,7 |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | 6,7 |
| **RESULTS** | | |  |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | 7, Fig 1 |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | Table 1 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | 9,10,11 |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | 9,10,11 |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | 9,10,11 |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | 9,10,11 |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | 9,10,11 |
| **DISCUSSION** | | |  |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 11, 12 |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 12,13 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 15 |
| **FUNDING** | | |  |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | Not applicable |