Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

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Master Thesis

Nutritional status, dietary intake and factors influencing the eating behavior of seafarers working on merchant vessels: Results from the "e-healthy ship" cross-sectional study

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Abstract

Background: The prevalence of risk factors for lifestyle-related diseases, such as cancers and cardiovascular disease, was found to be high among seafarers. However, studies on lifestyle-factors often lack detailed information about health behavior changes at sea. Regarding nutrition aboard ships, a few studies have reported unfavorable eating habits. As previous research failed to include workers from the largest seafarer nations of South-East Asia, the aim of this study was the assessment of the nutritional status and the dietary intake, as well as to understand the individual and environmental factors influencing the seafarers' eating behavior among Burmese, Filipinos, and Europeans.

Methods: In the course of the "e-healthy ship" project, Burmese (n=20), Philippine (n=27) and European (n=22) seafarers were investigated aboard three merchant vessels of two German shipping companies. Data was gathered by multiple assessments, such as weighing, blood collection, questionnaires, smartwatches, and the 24-hour dietary recall interview. Nutritional intake was compared to the DACH dietary reference values.

Results: Overweight was prevalent, and measured blood markers deviant from their reference range. Seafarers stated to have gained weight since they started seafaring, however, if weight gain took place at home or sea remained open. The average nutrient intake was above the dietary reference values for sodium, protein, and fats, such as saturated fatty acids and cholesterol, while below for carbohydrate, fiber, vitamin A, folate, vitamin C, vitamin D, vitamin E, potassium, calcium, and iodine. Moreover, seafarers stated to consume more vegetables, fruits, and fish at home but less sausage, noodles, chips, salted nuts, cola, coffee, sweetened tea, and spirits compared with their time at sea. Queries regarding innovative intervention methods, such as an "e-learning" app, received high agreements.

Conclusions: The nutritional status and the recorded dietary intake turned out to be unfavorable, and eating behavior negatively influenced at sea. An intervention promoting healthy nutrition onboard vessels is necessary in order to address all levels related to nutrition within maritime shipping, to improve the nutritional status as well as the diet of seafarers, and therefore to reduce seafarers' risk for lifestyle-related diseases.

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I dedicate this thesis to my father Gert Neumann – you are still being missed!

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List of Abbreviations

BMI	Body-Mass-Index
CVD	Cardiovascular Disease
DGE	German Society for Nutrition
DMEI	Daily Metabolizable Energy Intake
DRV	Dietary Reference Values
E	Energy (in tables only)
EPA	Eicosapentaenoic acid
FA	Fatty Acid
SeaNut study	Seafarer Nutrition Study
TDEE	Total Daily Energy Expenditure
ZfAM	Institute for Occupational and Maritime Medicine

Glossary

Dietary Reference Values: “Dietary reference values (DRVs) is an umbrella term for a set of nutrient reference values that includes the average requirement (AR), the population reference intake (PRI), the adequate intake (AI) and the reference intake range for macronutrients (RI). These values guide professionals on the amount of a nutrient needed to maintain health in an otherwise healthy individual or group of people. DRVs also include the tolerable upper intake level (UL), which is the maximum amount of a nutrient that can be consumed safely over a long period of time.” (c.f. European Food and Safety Authority, 2019)

Healthy worker effect (or Healthy user bias): “A cohort study is the most important study design for analyzing industrial exposures. One of the sources of bias in industrial cohort studies is the healthy worker effect (HWE). HWE consists of two selection processes: healthy worker hire and healthy worker survivor.” (c.f. Sobala, 2008)

1 Introduction

Seafaring is traditionally perceived by the public as a risky occupation. Piracy, maritime disasters, and accidents at sea are threats that have been present over centuries and are still popular topics for movies or news broadcasts. However, these occupational hazards have declined over the past centuries and played a less critical role in recent seafarer mortality rates (Oldenburg, Baur, & Schlaich, 2010b; Roberts, 2008; Roberts, Nielsen, Kotłowski, & Jaremin, 2014) since causes of death, such as major lifestyle-related diseases like various forms of cancer and cardiovascular disease have come more prevalent in Western industrialized countries. Prevalence-based studies regarding these diseases within the maritime setting are rare; therefore, the investigation is limited to recent studies.

A British registry-data based study from the years 1919 to 2005 revealed that seafarers were at higher risk for cardiovascular disease (CVD) than the general British population (Roberts and Jaremin, 2010). In this study, the authors explained the results of earlier investigations that found a decreased risk for CVD among active seafarers at sea by attributing the results to the "healthy worker effect". Also, the mandatory health checks for seafarers might have contributed to distortions as workers diagnosed with a highly increased risk for major morbidities like CVD were prohibited from seafaring. Various studies from Western European and Middle Eastern countries that support these findings suggest that hypertension, high triglycerides, diabetes, obesity, metabolic syndrome and behavioral risk factors, such as smoking, high loads of stress, physical inactivity, and an unhealthy diet are prevalent among seafarers (Baygi et al., 2016, 2017; Hansen, Hjarnoe, & Jepsen, 2011; Jepsen & Rasmussen, 2016; Møller Pedersen & Jepsen, 2013; Nas & Fışkın, 2014; Oldenburg, 2014; Oldenburg, Baur, & Schlaich, 2010a; Pougnet et al., 2013; Scovill, Roberts, & McCarty, 2012; Tu & Jepsen, 2016; von Katzler et al., 2019).

Pukkala et al. (2009) investigated cancer registry data from five Northern European countries and found seafaring among the occupations with the highest standardized incident rates for all forms of cancers combined. In Danish registry data of more than 44.000 seafarers, the incidence of gastrointestinal, respiratory and genitourinary cancer for both genders was found to be higher compared to non-seafarers (Petersen, Volk, Kaerlev, Hansen, & Hansen, 2018). The risk of lip cancer and mesothelioma was higher among male seafarers than in the Danish

male population. Even though occupational exposure to asbestos and ultraviolet radiation seemed to affect cancer development and the course of the disease, the majority of cancers among seafarers are expected to be lifestyle-related (Oldenburg, Baur, and Schlaich, 2010b; Petersen et al., 2018; Pukkala et al., 2009).

While the prevalence of the risk factors for cancers and cardiovascular disease have at least partially been investigated, studies about the seafarers' lifestyle often lack detailed information about the health behavior changes at sea, failing to give deeper insights for the environmental and individual factors underlying these changes. Regarding nutrition aboard ships, some studies reported overeating, increased consumption of meats and foods high in fat or salt, and reduced consumption of fruits, vegetables, cereals, and dairy products (Babicz-Zielińska & Zabrocki, 1998; Hjarnoe & Leppin, 2014b; Zyriax et al., 2018). In the "Seafarer Nutrition" (*SeaNut*) Study, Zyriax et al. (2018) were the first to perform detailed analyzes about the nutrient supply of the diet of European and Kiribati seafarers. However, their results did not offer any information about the seafarers' nutrition outside of the maritime setting. Consequently, researchers are unable to confirm whether or not poor eating behaviors at sea improved when a seafarer returned home.

Additionally, the majority of these maritime nutritional studies were conducted among Europeans, as well as Kiribati seafarers. Hardly any studies examined workers from great seafarer nations, like those in Asia. This is unfortunate because most seafarers come from Asia (International Chamber of Shipping, 2019). At 1,2 million, the most considerable part of the total seafarer population comes from the Philippines (International Labor Organization, 2014). The limited sampling of seafarers studied combined with the limited variables studied from the food ordering conditions and food preparation processes to the actual eating pattern of the individual seafarer indicate that the overall knowledge regarding the food situation on merchant vessels is somewhat limited. Consequently, there is a lack of knowledge on how to successfully implement and maintain a nutrition intervention in the maritime setting, which may be a reason for the lack of intervention studies on the other hand (Hjarnoe and Leppin, 2013). The aim of this investigation anchored in the "e-healthy ship" project, was to generate hypotheses and supplement prior literature concerning seafarer nutrition, which then allowed a more targeted development of the intervention adopted to the maritime setting and seafarer needs.

2 Context of the Study

This chapter provides some background information about the study's context. First, it describes the German shipping industry and the legal foundations for the working and living standards of seafarers, followed by working and living conditions of seafarers. Finally, this section gives a brief overview about health promotion previously carried out on merchant ships.

2.1 German Shipping Industry

The Federal Ministry for Economic Affairs and Energy (2017) reports that Germany accommodates around 2700 seagoing vessels and more than 360 shipping companies, which ranks the German merchant fleet fourth among the largest shipping nations and first in ownership of container-carrying capacities among all countries. Thus, the maritime industry plays a relevant part of the German economy with an estimated annual revenue of 50 billion Euro and about 400.000 associated jobs (The Federal Ministry for Economic Affairs and Energy, 2017). It covers the whole range of industrial activities with the transportation of containers being the foremost, followed by cargo vessels, bulk carriers, mineral oil tankers, passenger and cruise ships, and specialized transporting vessels like heavy load carriers or chemical tankers. Additionally, the "Maritime Agenda 2025" lists nine Federal Government areas of action and maritime industry policy objectives and interestingly, in point 6 suggest the implementation and use of the opportunities of digitalization (The Federal Ministry for Economic Affairs and Energy, 2017).

2.2 Legal Foundations

In 2006 the International Labour Conference adopted the Maritime Labour Convention (MLC), which came into effect on 20th of August 2013 and constituted the legal foundation for the working and living standards of seafarers on merchant ships(International Labour Organization, 2017). The implementation was understood as a large success as the *"MLC 2006 introduces for the first time a unifying legal regime for the rights of the seafarers from the double perspective of labour law and international maritime law"* (Adăscăliţei, 2014). Also, the

food and catering regulations were determined and the purpose described in the following terms (International Labour Conference, 2006):

1. *"Each Member shall ensure that ships that fly its flag carry on board and serve food and drinking water of appropriate quality, nutritional value and quantity that adequately covers the requirements of the ship and takes into account the differing cultural and religious backgrounds."*

2. *"Seafarers on board a ship shall be provided with food free of charge during the period of engagement."*

3. *"Seafarers employed as ships' cooks with responsibility for food preparation must be trained and qualified for their position on board ship."*

Despite being deemed a tremendous success, the MLC failed to go into detail about regulations and recommendations for food and catering. Many formulations, for example, "*appropriate quality, nutritional value and quantity [of food]"* or *"catering staff shall be properly trained"*, did not include further explanations. Also, the certificates that verify seafarers as ship cooks can be issued by "any approved body", which implies a consistent level of quality cannot be guaranteed. Complex tasks like ordering food for a crew requires experience, expertise, and personnel that has received improper training.

Additionally, the MLC included recommendations for catering instead of mandatory rules. It cannot be assumed that a uniform high-quality food supply is regulated on every merchant vessel; thus, it is still the responsibility of the shipping companies to ensure at least minimum standards for their working personnel. In response to this loophole, the MLC (2006) recommends cooperation with national and local organizations and authorities. These organizations can offer information material about proper catering and if necessary, install or reinstall a proper catering.

2.3 The Working, Living and Eating Situation on Merchant Vessels

A typical ship's crew works ashore for several months and predominantly consists of male seafarers from different national backgrounds, speaking different mother tongues (Mellbye and Carter, 2017). A study by Oldenburg, Jensen, and Wegner (2013) that investigated the

average contract length of seafarers, found that contracts of captains and officers lasted 4.8 months while lower crew rankings stayed for 8.3 months on the same ship. Seafarers usually work every day of the week, with working times exceeding 37 hours per week (Carotenuto, Molino, Fasanaro, and Amenta, 2012). Especially on deep-sea vessels, periods of two to three weeks spent at sea, without docking are usual. These extended periods at sea cause boredom and feelings of social isolation due to limited leisure time possibilities and the separation from family and friends (Mellbye and Carter, 2017). On newer and modernized vessels, ship officers' jobs are mostly sedentary, while lower crew ranks are exposed to more physically demanding work (Oldenburg, Jensen, Latza, & Baur, 2010).

The living situation of seafarers on ships can be highly diverse. On the one hand, it depends on the vessel type and workplace on board. On the other hand, recreational rooms including exercise space and equipment, smoking regulations, food provisions as well as food quality determine the seafarers' opportunities to ensure a work-life-balance (Hjarnoe and Leppin, 2013).

On German merchant ships, meals are usually served separately. While the officers and engineers, who are often of European origin, eat in the officers' mess room, the crew, who are often of low-wage Asian countries, gather in the crew mess room. The food supply of both mess rooms differs depending on cultural eating preferences. Three warm meals and two coffee breaks are offered for free each day, and a ship store provides snacks and drinks. However, food quality and quantities onboard are not influenced by the seafarers as space for food storage on board is limited, and the food supply depends on the contracted catering company. (c.f. Oldenburg, Harth, & Jensen, 2013)

Food was described as one of the few pleasures seafarers have during the day, which leads to frequent overeating, with three main meals and 2-3 snacks a day (Hjarnoe and Leppin, 2014a, 2014b). A Polish study from Babicz-Zielińska and Zabrocki (1998) indicated that seafarers and fishers surpassed the recommended daily level of calorie intake substantially. Further studies show that nutrition in a male-dominated workplace was found to favor high-fat, high-salt, and meat-oriented foods with lower proportions of vegetables or fruit. These findings were supported by the results of the *SeaNut* study, which investigated food offerings onboard and dietary intake of European and Kiribati seafarers on German merchant vessels (Zyriax et al., 2018). The average food offering of "meat, sausages, eggs and fish" and "fats and oils" on

board was found to be twice as high or higher compared to the recommendations of the German Society for Nutrition (DGE). “Dairy products,” “fruits,” “vegetables and salads,” as well as “cereals and potato” were on average offered slightly less than recommended. These results were in line with the dietary assessment. Many seafarers followed a diet high in fat and protein and low in carbohydrates and fiber. These numbers prove that many seafarers did not meet DGE recommendations for several micronutrients, indicating room for improvement among food supply and eating habits of the target group. Primarily, the data from the *SeaNut* cohort was used to analyze the health and nutrition status of seafarers overall. The project was also interested in the differences between the cultural backgrounds, as a higher weight gain among the Kiribati seafarers was reported previously by the shipping company. While Zyriax et al. (2018) found that the daily energy intake of the Kiribati seafarers was on average higher by more than 300 kcal compared to the European seafarers, Westenhoefer et al. (2018) concluded that the cultural background can be a valid reason for differences in food and body shape attitude and subsequent eating behavior. These then may lead to different food-related health outcomes among seafarers, even though they are living in the same food environment.

In general, a multitude of factors influences the seafarer diet. Jezewska, Babicz-Zielińska, Leszczynska, & Grubman (2009) listed climatic and environmental factors, financial capabilities of the employer, the imagination and skill of the people preparing the meals and the energy expenditure at work. Moreover, Oldenburg, Harth, et al. (2013) described different dietary habits with the multi-ethnic crews, a lack of self-determination in the selection of food, different food supply for the different mess rooms, limited opportunities for physical activities in leisure time and exceptionally high levels of psychosocial stress in the seafaring occupation. Consequently, Oldenburg, Baur, and Schlaich (2010b) mentioned the seafarers’ living situation and its influence on lifestyle factors like nutrition as one of the major sources of impact for the development of disease on the sea.

2.4 Health Promotion in the Shipping Industry

To the best of the author's belief, there have only been three intervention studies in the maritime shipping industry that focused on nutrition in the past 25 years.

A Finnish study from 1997 targeted the self-care of sailors by providing education on healthy lifestyle topics, such as diet, physical activity, smoking, and alcoholism. A one-year follow-up to this intervention reported a perception of healthier meals as well as a decrease in mental stress and an increase in job satisfaction (Saarni, Laine, Niemi, and Pentti, 2001).

In a Danish intervention study, 49 seafarers who worked in the galley of two shipping companies participated in a cooking course (Hjarnoe and Leppin, 2014b). Qualitative interviews were carried out with 35 of the seafarers at the beginning of the study and one year later. The researchers identified organizational challenges for a healthy diet on board, such as a low frequency of supply options, high prices of fresh fruits and vegetables in Scandinavia, as well also restricted storage space and limited cooking skills and food expertise of cooks due to a lack of training. However, participants of that study provided positive feedback about the cooking course and the way it promoted a healthy diet. This feedback was also accompanied by a significant change in the self-reported eating behavior at follow-up. In another intervention conducted by the same researcher team, health education courses about smoking cessation, individual exercise guidance, and extra health check-ups resulted in significant improvements in seafarers' levels of fitness, reduction of daily sugar intake and metabolic syndrome (Hjarnoe & Leppin, 2014a). Changes in dietary behavior and waist circumference showed a positive trend.

These studies suggest that nutrition of seafarers can be improved by interventions. Nevertheless, there still is a lack of fundamental research on seafarers' diet on which a seafarer-adapted intervention could be based. This admittedly raises the question of how practical previous approaches have been.

3 Objectives

This investigation followed an explorative cross-sectional approach with the main purpose to evaluate, analyze and generate hypotheses about possible connections between the seafarers' nutritional status and dietary intake, as well as their working and living conditions on board of merchant vessels. The main objective was to understand the individual and environmental factors influencing the seafarers' eating behavior, the assessment of the seafarers' nutritional status, dietary intake on board of merchant vessels, and differences in dietary intake compared to "at home." The explorations were conducted for Burmese, Philippine and European seafarers, extending prior research that only focused on European and Kiribati citizens. Furthermore, personal preferences regarding food, conditions while eating, and the use of health promotion apps were queried since this information could be helpful for the development of a seafarer-adapted nutrition intervention. The key questions the explorative approach is based on are as follows:

<u>1. Nutritional status:</u>

i. Which percentage of seafarers are overweight or obese according to the Body-Mass-Index?
ii. How did the seafarers' weight change since the workers started seafaring?
iii. Are the measured blood parameters within their reference range?
iv. Do Body-Mass-Index, weight change, and blood values differ among Burmese, Philippine, and European seafarers?

<u>2. Energy balance and nutrient intake:</u>

i. How much energy is spent by a seafarer on average a day?
ii. How much energy is consumed by a seafarer on average a day?
iii. Does the energy balance differ among Burmese, Philippine, and European seafarers?
iv. Does the dietary intake meet the recommendations of the DGE concerning the nutrient level?
v. Does the dietary intake differ among Burmese, Philippine, and European seafarers?
vi. How many of the seafarers use supplements? Which type of products are used?

3. Differences between seafarers' dietary intake on the ship and at home:

i. Do the number of meals per day differ at home from those days at sea?
ii. Is the number of meals a day changed differently among Burmese, Filipinos, and Europeans comparing their onboard and at home meals?
iii. Does the consumption of food groups and drinks differ at home?
iv. Is the consumption of food groups and drinks changed differently among Burmese, Filipinos, and Europeans comparing their onboard and at home intake?

4. Environmental factors that influence the seafarers eating behavior on the ship:

i. Are fresh fruits and vegetables available onboard?
ii. Is the cook taking the different nationalities into account?
iii. Are there meal sources used besides the kitchen (e.g., ship store, fishing)?
iv. What are seafarers' barriers in the ship environment to eat healthily?

5. Individual factors that influence the seafarers eating behavior on the ship:

i. How satisfied are seafarers with the food supplied on their ships?
ii. Are seafarers interested in information about healthy food?
iii. What do seafarers consider as healthy diet?

6. Seafarers' attitudes about food, eating, and health promotion apps

i. What are seafarers' personal food preferences?
ii. How important are various aspects of the eating conditions?
iii. Do seafarers use apps to control their eating behavior?
iv. Would seafarers be willing to use apps to control their eating behavior?

4 Methods

This section describes the project “e-healthy ship” and this study's methodical approach of the study, including the study design, data collection, measurements, statistical analysis, and given to the subjects.

4.1 “e-healthy ship”

The Institute of Occupational and Maritime Medicine (ZfAM, 2018a) describes the e-healthy ship as *“[...] an interdisciplinary, EU-funded project to improve [seafarers’ health and] health management on vessels without doctors on board”* (para. 1) which started on 01.07.2017 and aims for completion until 30.09.2021. During the first project stage, researchers from the ZfAM and the University Hospital Hamburg-Eppendorf investigated seafarers health status, behavior, and knowledge in various fields: Nutrition, physical activity, stress, fatigue, skin condition, ergonomics and sleep quality (ZfAM, 2018b).

Onboard of merchant vessels of the two German shipping companies “Peter Döhle Schiffahrts-KG” and “Roth,” medical examinations, questionnaires, interviews, and observations were conducted, and health data gathered. In cooperation with experts and guided by the results of the first project stage, the development of an IT-based health promotion intervention was planned and will be implemented in later stages of the project.

The projects’ financial outlay of approximately 1.86 million Euro was mainly funded by the European Regional Development Fund and the Hamburg Authority for Health and Consumer Protection and increased by the project partners’ funds. Further stakeholders of “e-healthy ship” were the “Hamburg port health center,” the “union of German shipping companies”, the “department of ship security and medical service the sea” and the seafarers outpatient clinic “Groß-Sand.”

4.1.1 Data Collection

Data collection was executed on various ships and routes in a duration of nine to 14 days over an overall time frame of four months. All interviews and measurements were taken on board of two container vessels identical in construction and one bulk carrier of two Hamburg based

shipping companies "Peter Doehle Schifffahrts KG" and "Roth" (see Table 1). In order to gather data that allows a representative induction conclusion for the general seafarer population, the chosen cooperating shipping companies differed heavily in financial capital, fleet size and the capacity of the vessels and its construction size.

Table 1. Merchant Vessels Hosting the Project

Ship no.	Investigation period	Flag	Crew Size	Ship Type	Capacity[a]
1	15. - 27.05.2018	Portugal	24	container vessel	140.259
2	03. - 16.07.2018	Liberia	24	container vessel	140.259
3	07. - 15.09.2018	Liberia	18[b]	bulk carrier	23.662

Note. [a] Data are given in gross tanker tonnage. [b] During the investigation period, a crew change took place. Thus, 26 seafarers were able to participate in the study (standard crew size of 18 and 8 substitutes)

4.1.2 Recruitment of Study Participants

The three ships offered a total of 66 working seafarers. However, during the researchers stay on board of ship three a crew exchange of eight seafarers took place and expanded the possible total number of seafarers participating to 74. With 73 of 74 seafarers (98.6%) joining the study, the recruitment rate on the ships visited was of high success. Solely one seafarer declined due to personal reasons. Participation in nutrition examinations was slightly decreased as 70 seafarers (94.6%) attended the sessions. Three crew members dropped out due to work-related reasons (see Figure 1).

4.1.3 Instructions, form of consent, ethical considerations, data safety

Firstly, the shipmasters of the selected ships were invited by their shipping companies to host the project. After their agreement in order to cooperate with the research team, the ship crews were informed about the upcoming project a few weeks beforehand. Flyers sent by the shipping companies via email were printed and distributed on board of the ships (see Appendix A). Besides general project information and pictures of the researchers' team, the flyers also included a statement of the shipping company management about the seafarers' advantages and possible motives to support "e-healthy ship." Furthermore, an incentive was included that would offer individual health feedback to every participating subject after the data was collected and analyzed (Appendix B).

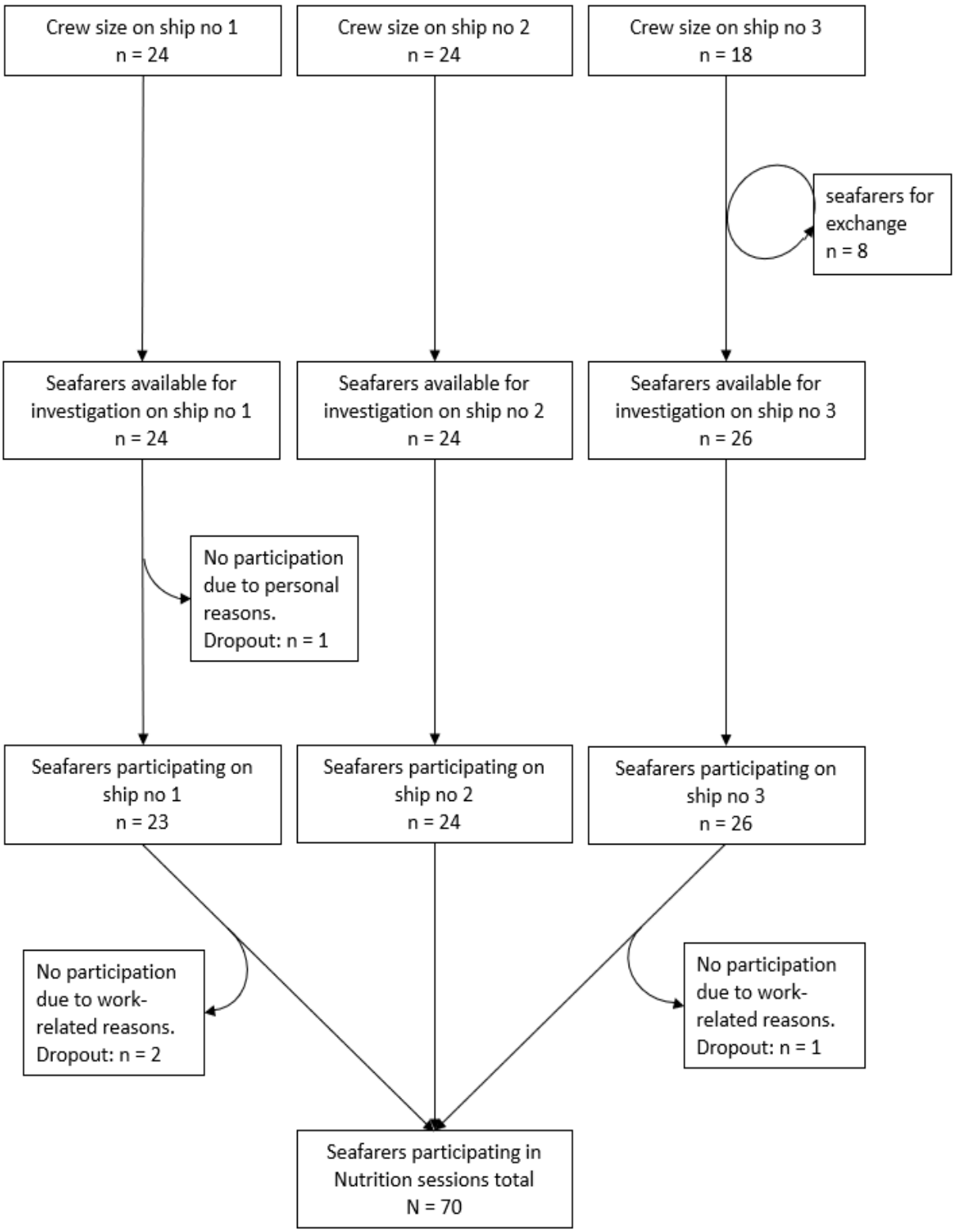

Figure 1. Flow Diagram on the Recruitment of Subjects

At the beginning of every journey, the research team asked the shipmasters to gather the whole crew for a meeting where the content and extent of the study was explained.

The crew understood that participation was voluntary, collected data pseudo-anonymized, and the handling of the personal health data confidential. Subjects were further, in accordance with the DGSVO, informed that they had the right to abort the study at any time without a given reason. Subjects also had the full decree over their data.

In this context, the declaration of consent was distributed (see Appendix C). To ensure that the decision of participation was independent of pressure from any third member party, subjects were requested to bring the form of consent to the first appointment with the researcher and decide about the participation there and then. Measurements were taken privately in a separated room.

Collected data was pseudonymized by assessing every participant with a random code number, which only allowed the researchers to trace back the identity with the help of a secure coding sheet. The code number was randomly determined by using the appropriate function in Microsoft Excel 2010. After data analysis, every participant received a "doctor's letter" by email or mail, which included the personal results of the health examinations.

The study obtained ethical consent from the Ethics committee of the Medical Association of Hamburg and was conducted according to the Declaration of Helsinki.

4.2 Measurements

Various methods and instruments for data collection were applied onboard. This chapter gives an overview of the measurements done.

4.2.1 Measurement of Height, Weight and Body Mass Index

Information about body height was taken from the seafarers' medical records, and body weight was measured by using a calibrated weighing scale from Kern®. As ship movements

might have impacted the results of the examination, measurements were conducted when ships were anchored at port. Weight examinations took place after an overnight fast, and seafarers wore only their underwear. Bodyweight was also taken from seafarers' medical record for those that did not participate in the weighing measurement.

Table 2. Determination of the Nutritional Status by the Use of Body-Mass-Index

BMI	Nutritional Status
Below 18.5	Underweight
18.5-24.9	Normal weight
25.0-29.9	Pre-Obesity
30.0-34.9	Obesity class I
35.0-39.9	Obesity class II

Note. Adapted from "Body Mass Index – BMI" by World Health Organization (2019). Table: Nutritional Status, para. 2.

The Body Mass Index (BMI) to evaluate body weight of a person in relation to his height and it is defined by body weight in kilograms divided by the square root of the body height in meters (World Health Organization, 2019):

$$\textit{Body Mass Index } (kg/m^2) = (\textit{body weight in kg}) / (\textit{body height in } m^2)$$

The BMI is utilized to evaluate the nutritional status of adults and serves as an indicator for the risk for several common diseases. Whereas a higher BMI is associated with increased risk of [...] "cardiovascular diseases, high blood pressure, […] some cancers and diabetes" (World Health Organization, 2019, para. 1) as well as adiposity. The nutritional status of the seafarers was determined by the BMI ranges (see Table 2).

4.2.2 Blood Sampling

Blood sampling was performed the morning after weighing as seafarers needed to be sober for both measurements. Blood was extracted from the earlobe. Samples were frozen instantly, and the cold chain of -20 degrees was maintained for the whole journey until the blood was analyzed for blood glucose and lipid profile by a German laboratory (Lademannbogen GmbH, Hamburg, Germany). The lipid panel is a blood sampling screening tool for certain abnormalities in lipids such as cholesterol and triglycerides, which serve as a risk indicator for certain diseases, e.g., CVD. Unfortunately, due to an error, the lipid profile was not analyzed for the crew of the first ship. The references values for blood glucose and the lipid profile were used according to the National Cholesterol Education Program III (2001). Values differing from standard were defined as cholesterol ≥200mg/dl, triglyceride ≥150 mg/dl, LDL cholesterol ≥160 mg/dl, HDL cholesterol ≤40 mg/dl and fasting blood glucose levels ≥110 mg/dl.

4.2.3 Energy Expenditure

The fitness smartwatch *Polar M640* by *Wear OS* by *Google™* was distributed among the participants at the beginning of the study. The smartwatch functionalities were explained and after several days of use, collected again. This allowed tracking health-related lifestyle behaviors like duration of physical activity as well as covered distances, sleep duration, and calories burned. Based on the output of burned calories, the total daily energy expenditure (TDEE) was calculated for every subject. The unit of measurement used was kcal. TDEE was conducted in order to assess the energy balance of the seafarers.

4.2.4 Energy and Nutrient Intake

Due to the seafarers' exposure to diverse occupational demands and working tasks, as well as varying cultural backgrounds and language barriers (Oldenburg, Baur, et al., 2010b), the assessment tool for food intake needed to be easily understood and applicable. Therefore, the instrument of choice was the 24-hour dietary recall, which was recommended earlier for the setting at sea by Oldenburg, Harth, et al. (2013). The 24-hour dietary recall is a standardized interview assessing the dietary intake before the interview. In contrast to other instruments, the interview also allows an exact determination of energy and nutrient intake (Linseisen et al., 2002) due to visual aid and beforehand preparations made by the researcher and the participants. Ecological validity was increased due to the simple execution of the interview, low effort on the participants' side and flexible time management adaptable to a work environment as it was presented here.

4.2.4.1 Preparation and Conduction of Interviews about Eating Habits

In preparation, dishes supplied by the kitchen were weighed by their ingredients, and pictures were taken (see Figure 2). Seafarers were given a food diary spreadsheet to record their daily

intake of food and drink (see Appendix D). Additionally, the seafarers were asked to take pictures of their main meals.

Figure 2. Sample Images for Weighing and Photo Documentation

The interview followed the standardized conversation guideline for the "24-hour recall" tool by Gibson (1990, pp. 37-39). For the query, the researcher used the wording as presented in Appendix E. Firstly, the interviewee was asked to remember all food and drink consumed during breakfast, lunch, dinner, and in between chronologically. The researcher noted all the dishes listed by the subject. Subsequently, portion sizes were estimated. Pictures taken by the researcher and the seafarer were compared and consumed amounts determined. Every seafarer participated in two to three food interviews.

That meals were determined precisely by comparing pictures and that the direct transparency regarding dish sizes and food intake amounts was given, turned out to be beneficial for the interviews. As the estimation of exact food intake is known to be the major weakness of the 24-hour dietary recall instrument, this procedure was added to ensure increased reliability and validity (Gemming, Doherty, Kelly, Utter, & Ni Mhurchu, 2013; Lazarte, Encinas, Alegre, & Granfeldt, 2012; Navarro, Cristaldo, Díaz, & Eynard, 2000). Further practical visual aids helped to bridge the language barrier between subject and researcher. To ensure a holistic overview of food intake, left-overs, and second servings were also identified. Close attention was paid to sugar-sweetened beverages, sweets, and other snacks that could be bought on board as well as other sources of food outside the kitchen servings.

Figure 3. Sample Image from a Food Interview

4.2.4.2 Processing of Food Data into Nutrient Data

During the interview, the gathered food information was directly recorded with the nutrition software *Ebispro 2011*, which contains nutrient data for more than 15.000 foods. Based on the measured weight, height, and calculated TDEE, the required amounts of energy and nutrient intake of each seafarer was determined. However, the results were analyzed as the mean of a collective, as suggested by Brussaard et al. (2002) for comparisons among different nationalities. It should also be mentioned that alcohol intake was solely analyzed in terms of its energy level. Risk consumption and addiction as in alcohol disease were disregarded in this study.

4.2.4.3 Dietary Reference Values for Nutrient Intake

The European Food and Safety Authority (EFSA, 2019) defines the dietary reference values (DRVs) as "*an umbrella term for a set of nutrient reference values"* (para. 1), which summarizes the average requirement, the population reference intake, the adequate intake and the reference intake range for macronutrients. The DRV can be used to check if the nutrient intake of a person fulfills the bodies' nutrient need to maintain health. For this study, it was intended to compare the mean nutrient values of the three nationality groups with each other, but also with appropriate nutrient recommendations. However, there are different DRVs for Burmese, Filipinos, and Europeans. DRVs that appeared eligible were published by four organizations: The DACH reference values were developed by the nutrition societies of Germany, Austria, and Switzerland (DGE, ÖGE, & SGE, 2019); the EFSA (2017) published DRV for the population

of members of the European Union; the Philippine Dietary Reference Intakes (PDRI) are the national recommendations from the Philippine Food and Nutrition Research Institute (2015), and the International Life Sciences Institute (ILSI) of the Southeast Asia region worked on a harmonization of national recommendations to joint DRV and published the settlements in the "Southeast Asian recommended daily allowances" (ILSI, 2005). However, the latter does not include some nutrient components as the experts of the participating nations were not able to agree on common reference values. Therefore, the ILSI recommendations were excluded from further considerations in this study. The DRVs of DACH, PDRI, and EFSA are shown in Table 3.

Table 3. Dietary Reference Values of DACH, PDRI, and EFSA

Nutrients		Dietary reference values		
		DACH	PDRI	EFSA
	Energy (E; kcal)	2500-2800	2140-2530	~2200-2676
	Water (ml)	1440	1610-1930	2500
Macronutrients				
	Protein (g/kg)	0,8	~1,2	0,83
	Protein (% of E)	10-12	10-15	12-20
	Fat (% of E)	<30	15-30	20-35
	Carbohydrate (% of E)	50<	55-75	45-60
	Fiber (g)	30	20-25	25
Vitamins				
	Vit. A (µg)	1000-1100	700	750
	Vit. B1 (mg)	1,2-1,3	1,2	0,1[a]
	Vit. B2 (mg)	1,3-1,4	1,3	1,6
	Vit. B6 (mg)	1,6	1,3-1,7	1,7
	Folate (µg)	300	400	330
	Vit. B12 (µg)	4	2,4	4
	Vit. C (mg)	110	70	110
	Vit. D (µg)	20	5-15	15
	Vit. E (mg)	12-15	10	13
	Vit. K (µg)	70-80	61	70
Minerals				
	Sodium (mg)	1500	500	n.a.[b]
	Potassium (mg)	4000	2000	3500
	Calcium (mg)	1000	750-800	950-1000
	Magnesium (mg)	350-400	240	350
	Phosphorus (mg)	700	700	550
	Iron (mg)	10	12	11
	Zinc (mg)	14	6,5	7,5-12,7
	Iodine (µg)	180-200	150	150

Note. [a]Unit in mg/MJ of energy. [b]n.a.=not applicable – the reference value for sodium is still in the discussion by EFSA (2019).

As for the intended comparison, it was decided to keep the analysis as simple as possible and in favor of the DACH recommendations, that were also utilized by *Ebispro 2011*. Regarding the more explorative objective of this study, the small number of 24-hour dietary recall interviews did not serve as a database to investigate this further.

The DRV of the organizations were partially consistent with each other but also differed considerably for some nutrients. Recommendations are usually based on the average anthropometrics of a population, further factors like latitude, climate, air pollution, social and ethnic groups and average additional needs due to physical activities (EFSA, 2017). As a consequence, the recommendation for different nationalities and ethnicities do vary. A z-standardization of data to the seafarers' respective national recommendations could be useful in order to compare the quality of the dietary intake of the seafarer nations based on their DRV. However, on the one hand, there are no country-specific DRV for Burmese, and on the other hand, the dietary requirements of a seafarer at sea might differ from the needs in their home country respectively due to varying climate, working areas and leisure activities. Moreover, one focus of this study was the differentiation of the three presented nationalities.

A z-standardization would negatively affect the possibility to compare the nutritional intake on a purely quantitative level. It appeared more reasonable to compare the nutrient group means than to compare the percentage of accomplishment for recommendations, and thus it was refrained from z-standardization.

4.2.4.4 Limitations of Measurements for Energy and Nutrient Intake

The information gathered with the 24-hour dietary recall tool depends on the participant's memory and willingness to mention all foods consumed, which usually results in 15% to 20% of underreporting in interviews that were conducted by qualified personnel (Johansson, Wikman, Ahren, Hallmans, & Johansson, 2001; Poslusna, Ruprich, de Vries, Jakubikova, & van't Veer, 2009). Therefore, underreporting should always be taken into consideration when the results of 24-hour dietary recall interviews are analyzed. However, the unique environment that presented itself on the ship with only few food sources, limited food variety on board and supply bottlenecks of catering companies the variety of food options was narrowed, which increased the possibility high-quality results in data collection.

Moreover, the quality of the gathered information by the interview also depended on the quality of the conversion from food to nutrient data afterward. The nutrition software *Ebispro 2011* operates with the nutrient information of the German Nutrient Data Base and DACH reference values for nutrient intake. The German Nutrient DataBase is a reliant source for nutrient information of foods in Germany (Bundesministerium für Ernährung und Landwirtschaft, 2017). However, as the investigated ships could have loaded their foods anywhere in the world, nutrient information for the same food product may vary compared to German standards. Additionally, it should be mentioned that the author observed that *Ebispro 2011* rounds nutrient values several times during the process which might lead to minor data errors. For example, the mean for TDEE should comply with the sum of means for carbohydrate, protein, fat, and alcohol, but slightly does not.

The DACH dietary reference values for nutrient intake were compiled for German, Austrian, and Swiss normal-weight people, and are age-specific (Deutsche Gesellschaft für Ernährung e. V., 2019). As discussed earlier, it should be taken into consideration that these DRVs may not meet the real nutrient requirements of all participating seafarers and understood as a rough orientation for quantities of seafarer's nutrient intake only. As the definition states, some of the DRV are estimates, and a safety coefficient was included in the recommendation for every nutrient (Bechthold, 2009). Therefore, it does not necessarily mean that a person is malnourished because the DRV is not met by 100%.

4.2.5 Questionnaires

Due to the different nationalities, and thus possible language barriers on the part of the seafarers, particular working conditions, and the working environment of the ship, there were no validated questionnaires found in the scientific literature that seemed appropriate. However, single questions or sets of questions from validated questionnaires or questions used in other studies were taken for compiling optimized and standardized questionnaires that would suit the study population. Additionally, several specific questions were newly created.

The finalized questionnaires were entered into the IT survey tool *iQuestion*, and the *iQuestion*-app was installed on four iPad Air of the fifth generation. On the ship, the seafarers were asked to fill out the questionnaires on the iPads. The use of tablets also enabled the seafarers

working in late or night shifts to participate in the surveys independent from their sleeping schedule. The offline availability of the *iQuestion* services was the decisive driver for the tool as internet connections on the sea are expensive and not always possible.

Table 4. Questionnaires, Average Completion Time and Topics

Questionnaire	t	Topics
Demographic & Occupational Information	5	- Demographic information - Occupational information
Main Questionnaire	20	- Food sources on board - Amount of foods & drinks consumed at home - Comparison of eating/drinking behavior of seafarers ashore & offshore - Satisfaction with food - Influence factors on eating behavior on board
All Seafarers	15	- Interest in food and food knowledge - Food preferences
24h-recall addition	5	- Food sources on board - Supplementation - Weight development
Use of Apps	5	- Use of apps to control their eating behavior

Note. t = estimated average time (in minutes) needed for completion

Seafarers were asked to fill out five questionnaires. There was a general survey about demographic and occupational information (see Appendix F), as well as four different nutrition-related questionnaires (see Table 4). To complete all five surveys, the seafarers needed a maximum of 60 minutes.

4.2.5.2 Main Questionnaire

The “Main Questionnaire” (see Appendix G) mainly asked about differences in eating behavior at home compared with onboard and the decisive factors regulating these differences. The health literacy questionnaire HLS-EU-Q86 provided some questions that were adopted about the regular frequencies in which meals, food, and drinks in the home country were consumed (The HLS-EU Consortium, 2012). Against this background, seafarers then evaluated if the foods or drinks were consumed on a 7-point Likert scale that ranged from "not at all, considerately less, somewhat less, equal, somewhat more or considerately more" while being onshore. Furthermore, some questions about the food satisfaction and “food and nutrition situation on board” by Westenhoefer et al. (2018) were added, while questions about “barriers to eat healthy” by Ashton, Hutchesson, Rollo, Morgan, & Collins (2017) and self-developed questions about the “importance of the conditions of eating” completed the questionnaire.

4.2.5.3 All Seafarers Survey

The “All Seafarers” (see Appendix H) survey only involved self-developed questions that were supposed to gather information about different views on the food and nutrition situation among seafarers, like “self-evaluation of food knowledge”, “interest in food information”, “knowledge about recommendations for a healthy diet” and “personal attitudes about food, eating and health promotion apps”. Most of the questions worked with a four or six-point Likert scale ("I fully disagree, I slightly disagree, I slightly agree, I fully agree") and also forced-choice dichotomous (“yes/no”) questions were included. The questions for the topic “knowledge about recommendations for a healthy diet” were partially self-developed and partially inspired by the “Healthy Eating Plate” (Harvard School of Public Health, 2019).

4.2.5.4 24h-recall Addition

Before the 24-hour dietary recall interview, the participant was asked to complete the “24h-recall add” (see Appendix I) questionnaire, as it provided questions that added up to the whole picture of eating behavior on board, such as if other food sources than the kitchen or supplements were used, and if so, which exactly and how often. Also, information about the weight change, as suggested by Klipstein-Grobusch, Kroke, and Boeing (1998) was requested. In order to assess weight development subjects were asked to give their retrospective weight at the age of 20, 30, 40, 50 and 60 years in self-assessment, so that the subjects could be categorized into three categories ("weight loss, weight gain, weight stable").

4.2.5.5 Use of Apps to Track Eating Behavior

Like the name “Use of apps” (see Appendix J) already states, the seafarers were asked, if they were using apps to track their eating behavior and if so, they were requested to name it. Furthermore, the willingness to use various functionalities of such a tool was tested. All questions were self-developed.

4.3 Study Design and Subject Participation

The study was a cross-sectional study with several measurement points that were aggregated to different categories of the investigation: the questionnaires, physical measurements, blood sampling, and the interviews with its included preparations.

Table 5. Participation Numbers in Measurements

Measurements		Burmese[a]	Filipinos[b]	Europeans[c]	Other[d]	Total
Questionnaires						
	Demogr. & Occupat. Information	20	27	22	1	70
	Main Questionnaire	18	26	20	1	65
	All Seafarers	20	27	22	1	70
	24h-recall add	13	27	20	1	61
	Use of Apps	14	24	21	1	60
Interviews						
	24-hour dietary recall	13	13	11	0	37
Physical measurements						
	Polar watch	14	24	18	1	57
	Weighing	20	27	22	1	70
	Blood pressure	13	26	20	1	60
Blood sampling						
	Glucose	18	20	24	1	63
	Lipid profile	20	12	12	1	45

Note. N = 70. [a]n = 20. [b]n = 27. [c]n = 22. [d]n = 1.

4.3.1 Measurement Appointments Onboard

Every participant of the projects' nutrition part attended in at least four appointments. During the first meeting, all questionnaires were to be completed.

Afterward, the Polar watch was handed over to the subjects, and in preparation for the interviews, the researcher instructed the subjects to prepare for the upcoming interviews by taking notes and pictures of all foods and drinks consumed within 24 hours. These memory aids had to be brought to the second meeting, where the first food interview was performed. The same procedure was repeated for the third meeting, where the second food interview took place, and further meetings, if more than two food interviews were performed.

4.3.2 Participation in Measurements

Of the 70 seafarers participating, not everyone managed to complete all assessments. The eight seafarers that were signed off during the period on ship three had only limited time for participation in the investigations, and some officers from the engine staff argued that their load of work would be taking too much of their time. While nautical officers were able to combine the researchers' investigations with their "watch" on the bridge during sea days, engineers were not able to unite work and study. They appeared to be more stressed and less willing to fulfill additional tasks. In general, officers partially missed out on measurements, whereas seafarers with lower ranks proved to be more reliable.

Also, 24-hour dietary recalls were not performed on the second ship due to the absence of the researcher with the necessary expertise, while the nutrition-related questionnaires were handed out as usual. Overall, 24-hour dietary recalls were completed by 37 and questionnaires by 60 to 70 seafarers depending on the questionnaire (see Table 5).

4.4 Statistical Analysis

The nutrient data from *Ebispro 2011* and the questionnaire results from *iQuestion* were both exported to "Microsoft Excel 2016", a data set created and exported to "IBM SPSS Version 22.0" for statistical analyses. Firstly, test methods of descriptive statistics were performed and reported as mean ± standard deviation. Median, minimum, and maximum have partially been added for a more accurate representation.

The response options of the questions comparing food intake at home to at sea were coded and analyzed with one-sample t-tests (test value = 0). Therefore, "equal" was defined as 0 and the range response option as -2 to 2 ("considerately less" = -2, "somewhat less" = -1, "somewhat more" = 1, "considerately more" = 2).

Table 6. ES Indexes and Their Values for Small, Medium, and Large Effects

		Effect size		
Test	ES index	Small	Medium	Large
M_A vs. M_B for Independent Means	$d = \lvert \frac{M_A - M_B}{\sigma} \rvert$	0,2	0,5	0,8
Standardized Regression Coefficient	$r = \lvert \frac{z}{\sqrt{n}} \rvert$	0,1	0,3	0,5

Note. ES = population effect size. Adapted from "A Power Primer" by Jacob Cohen (1992). p. 157.

Differences between means among the three nationality groups were tested using one-factor ANOVAs with post-hoc Bonferroni tests or Kruskal-Wallis-tests with post-hoc Dunn-Bonferroni-Tests as appropriate. Categorical variables were presented as frequencies or percentages, and differences were examined using Chi-square tests or Fisher's exact tests for small numbers of cases. The significance level was set to alpha = 0,05.

In order to determine effect sizes independent of sample size effects, Cohen's d (1992) was calculated for interval scale data. When ordinal scale data was used, the $\chi 2$ and z-test statistics can be used to compute Pearson's standardized regression coefficients r in order to determine effect sizes (Rosenthal & DiMatteo, 2001). Values for small, medium and large effects are presented in Table 6.

5 Results

This chapter presents the results structured according to the key questions of this thesis.

5.1 Characteristics of the Study Sample

The individual and occupational characteristics of the study sample are shown in Table 7. Seventy male seafarers participated in the study, 20 Burmese, 27 Filipinos, 22 Europeans, and one Ethiopian. The Ethiopian seafarer was excluded from analyses as groups of one participant could not be statistically compared. Therefore, group comparison was calculated among Burmese, Philippine, and European seafarers only. The group of Europeans seafarers consisted of a cluster of workers from mainly Eastern European countries: Ukraine (8x), Romania (3x), Russia (3x), Poland (2x), Lithuania (2x), Germany (1x), Hungary (1x), Slovakia (1x) and Montenegro (1x).

Table 7. Individual and Occupational Characteristics as Means (Standard Deviations in Parentheses)

	Characteristics	Burmese[a]	Filipinos[b]	Europeans[c]	p
	Age (years)	41,5 (±9,6)	39,7 (±7,0)	37,5 (±12,4)	,407[d]
	Professional experience (years)	13,3 (±7,7)	13,1 (±6,6)	16,1 (±11,9)	,261[d]
Rank					
	Officer (n[%])	4 (20,0%)	2 (7,4%)	20 (90,9%)	< ,001[e]*
	Non-Officer (n[%])	16 (80,0%)	25 (92,6%)	2 (9,1%)	
Working area					
	Deck personnel (n[%])	14 (70,0%)	19 (70,4%)	11 (50%)	,280[f]
	Engine personnel (n[%])	6 (30,0%)	8 (29,6%)	11 (50%)	
The time onboard					
	Time since sign on (days)	107,2 (±109,8)	125,9 (±75,6)	68,9 (±43,1)	,054[d]
	Time until sign off (days)	116,4 (±117,3)	116,6 (±68,3)	77,8 (±44,3)	,196[d]
	Duration of stay (days)	223,6 (±28,8)	242,4 (±46,6)	146,7 (±43,7)	< ,001[d]*

Note. N = 69. [a]n = 20. [b]n = 27. [c]n = 22. [d]One-way ANOVA. [e]Fisher's exact test. [f]Chi-square test. The study population consisted of male seafarers only. *p < ,05

Groups for comparison were of almost equal in size, and no significant differences between groups regarding age, professional experience, working area, time since sign-on and time until sign-off were found (Table 7).

However, Fisher's exact test indicated that seafarers' rank differed significantly among the nationality groups ($\chi^2(2) = 43,2$; $p < ,001$). Adjustment of residuals showed that the rank "non-

officer" was significantly associated with Filipinos ($\chi^2(2) = 15,9$; $p < ,001$) and the rank "officer" with Europeans ($\chi^2(2) = 41,7$; $p < ,001$). No association was found for Burmese seafarers ($\chi^2(2) = 5,5$; $p = ,114$). Moreover, there was a significant statistical difference between the nationalities' duration of stay ($F(2,65) = 34,05$; $p < 0,001$). A post-hoc Bonferroni test indicated statistically significant difference between Europeans and Burmese ($\Delta M = 76,9$ days; $p < ,001$) as well as Europeans and Filipinos ($\Delta M = 95,7$ days; $p < ,001$). The means for the duration of stay for Burmese and Filipinos did not differ.

5.2 Nutritional Status

Body-Mass-Index

The means of the BMIs were similar for Burmese, Philippine and European seafarers ($M_B = 26,2$; $M_F = 26,2$; $M_E = 25,9$ kg/m^2) (see Table 8).

Table 8. Body-Mass-Indices as Means (Standard Deviations in Parentheses)

Characteristic	Burmese[a]	Filipinos[b]	Europeans[c]
BMI	26,2 (±2,7)	26,2 (±3,9)	25,9 (±3,6)

Note. N = 69. [a]n = 20. [b]n = 27. [c]n = 22. Kruskal-Wallis test indicated no significant group differences.

According to the "Obesity Classification" by the WHO (2019), the average weight of seafarers was within the classification of overweight. Thirty-one of 69 seafarers (44,9%) were of normal weight, whereas more than half of the seafarers were overweight (43,5%) or obese (11,6%). The distribution of the nutritional status of nationality groups is shown in Figure 4.

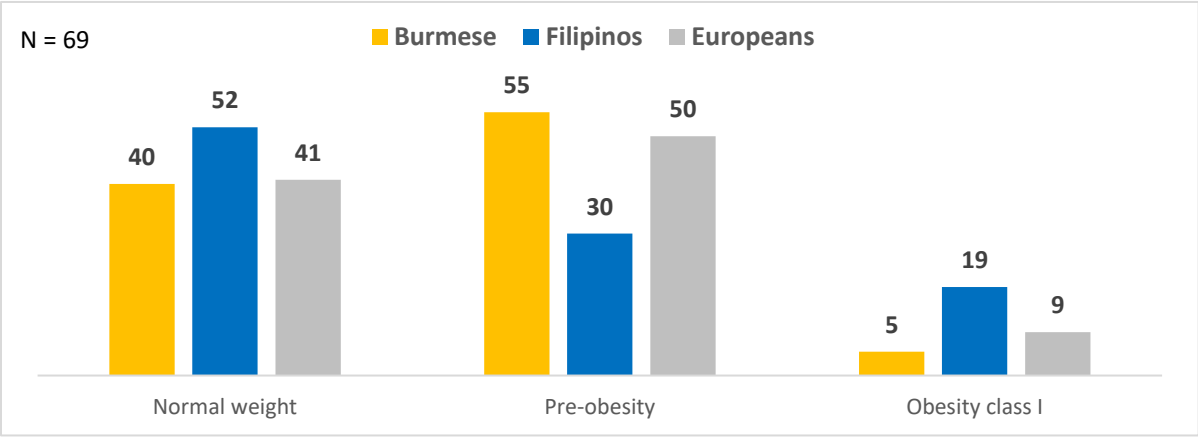

Figure 4. Nutritional Status based on Body-Mass-Index as a Percentage of the Groups
Fisher's exact test showed no significant differences for nutritional status among the nationalities.

Weight development

For Burmese subjects a total weight change since seafaring (M_B = 2,9 kg) and per year (M_B = 0,19 kg) was calculated, while total weight change (M_F = 5,2; M_E = 5,9 kg) and weight change per year (M_F = 0,40; M_E = 0,43 kg) for Filipinos and Europeans were almost double or more (Table 9). Nevertheless, the Kruskal-Wallis test failed to find statistically relevant results for group comparison in weight change since seafaring and weight change per year.

Table 9. Professional Experience and Change in Body Weight as Means (Standard Deviations in Parentheses)

Characteristic	Burmese[a]	Filipinos[b]	Europeans[c]
Weight change since seafaring (kg)	2,9 (±5,0)	5,2 (±6,4)	5,9 (±8,1)
Weight change per year (kg)	0,19	0,40	0,43
BMI change since seafaring (kg/m^2)	1,7 (±2,22)	2,0 (±3,09)	2,4 (±2,87)

Note. N = 58. [a]n = 12. [b]n = 27. [c]n = 19. Kruskal-Wallis tests indicated no significant group differences.

However, between 58% and 68% of the seafarers indicated that they gained weight, between 11% and 17% lost weight and the weight of 21% and 26% of the seafarers was stable since they started seafaring (Figure 5). A one-sample t-test was performed which tested the values of the total study population vs. a stable weight (test value = 0) and resulted in a significant positive test result (t(1,57) = 5,76; p < ,001). Therefore, Burmese, Filipino, and European seafarers gained body weight throughout practicing their occupation.

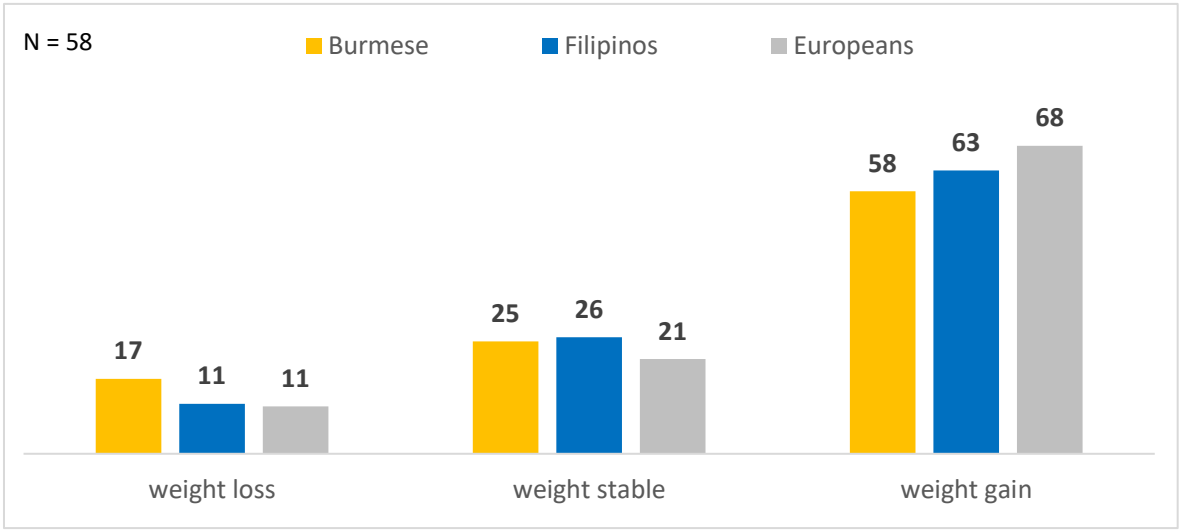

Figure 5. Weight Development since Seafarers Started with Occupation as a Percentage of the Groups
Fisher's exact test indicated no significant differences for nationalities.

Blood parameters:

Average blood glucose was high for the majority of seafarers. Among Burmese and Filipinos, the average measured blood glucose (M_B = 117,2; M_F = 111,7 mg/dl) was above and for Europeans (M_E = 111,7 mg/dl) just below reference values (see Table 10).

Table 10. Blood Glucose as Means (Standard Deviations in Parentheses)

Blood parameter	RV[d]	Burmese[a]	Filipinos[b]	Europeans[c]	χ^2	p[e]
Glucose (mg/dl)	<110	117,2 (±21,8)	111,7 (±21,8)	100,7 (±17,6)	7,72	,021

Note. N = 61. [a]n = 19. [b]n = 24. [c]n = 18. [d]Reference Values by Expert Panel on Detection Evaluation and Treatment of High Blood Cholesterol in Adults (2001). [e]Kruskal-Wallis test.

The Kruskal-Wallis test indicated differing levels in blood glucose for the nationalities ($\chi^2(2)$ = 7,72; p = ,021). Post-hoc Dunn-Bonferroni-Tests showed that blood glucose was significantly greater for Burmese than for European seafarers (z = -2,703; p = ,021) with a medium effect size (r = ,444). No differences were found between Europeans and Filipinos as well as Burmese and Filipinos.

Table 11. Lipid Profile as Means (Standard Deviations in Parentheses)

Blood parameter	RV[d]	Burmese[a]	Filipinos[b]	Europeans[c]
Triglyceride (mg/dl)	<150	151,3 (±70,8)	143,5 (±56,5)	128,3 (±43,1)
Cholesterol (mg/dl)	<200	187,5 (±27,2)	184,5 (±23,3)	192,9 (±30,6)
HDL (mg/dl)	>40	52,0 (±12,4)	55,3 (±8,0)	59,3 (±16,6)
Cholesterol/HDL	-	3,8 (±0,9)	3,4 (±0,5)	3,4 (±0,7)
LDL (mg/dl)	<160	134,4 (±29,7)	117,9 (±21,3)	129,6 (±29,8)
LDL/HDL	-	2,7 (±0,8)	2,2 (±0,4)	2,3 (±0,6)

Note. N = 44. [a]n = 20. [b]n = 12. [c]n = 12. [d]Reference Values by Expert Panel on Detection Evaluation and Treatment of High Blood Cholesterol in Adults (2001). Kruskal-Wallis tests indicated no significant group differences.

The average values for Triglyceride (M_B = 151,3; M_F = 143,5; M_E = 128,3 mg/dl) and total Cholesterol (M_B = 187,5; M_F = 184,5; M_E = 192,9 mg/dl) were remarkably high among all nationalities (see Table 11). Kruskal-Wallis tests showed no significant differences in group comparison for of the lipid profile.

5.3 Energy Balance and Nutrient Intake

Energy balance:

The descriptive results for the total daily energy expenditure and daily metabolizable energy intake (DMEI) are displayed in the following Table 12 and Table 13. The average TDEE resulted in being higher than the measured average DMEI among the nationalities and was similar for Europeans (M_E = 3021,3 kcal), Burmese (M_B = 3066,5 kcal), and Filipinos (M_F = 3111,0 kcal).

Table 12. Descriptive Statistics for Total Daily Energy Expenditure (kcal)

Descriptive	Burmese[a]	Filipinos[b]	Europeans[c]
Min	2183	1956	2102
Max	4696	4468	4078
Med	2970	3089	3005
M	3066,5	3111,0	3021,3
SD	540,9	456,8	480,3

Note. N = 297. [a]n = 62. [b]n = 139. [c]n = 96. n refers to the number for measured days. One-way ANOVA indicated no significant group differences.

The average DMEI was also similar among the groups (M_B = 2426,7; M_F = 2308,2; M_E = 2268,6 kcal. However, the DMEI values of the European group ranged from Min_E = 867 kcal to Max_E = 3485 kcal and thus strongly exceeded the range of the other groups which increased the risk of outliers in this small subgroup. However, the Kruskal-Wallis test failed to identify significant differences among the nationalities for the DMEI.

Table 13. Descriptive Statistics for Daily Metabolizable Energy Intake (kcal)

Descriptive	Burmese[a]	Filipinos[b]	Europeans[c]
Min	1502	1542	867
Max	3021	3176	3483
Med	2602	2396	2236
M	2426,7	2308,2	2268,6
SD	458,7	458,6	767,6

Note. N = 37. [a]n = 13. [b]n = 13. [c]n = 11. Kruskal-Wallis test indicated no significant group differences.

The energy balance resulted in being very negative among the majority of the seafarers. The lowest group mean was found for Burmese seafarers (ΔM_E = -639,8 kcal), followed by Europeans (ΔM_E = -752,7 kcal) and Filipinos (ΔM_E = -802,8 kcal). For energy balance, no significant group differences were found.

Table 14. Group Comparison: Means, Standard Deviations, and Results of the Kruskal-Wallis-Test for Daily Macronutrient Intake of 3 Seafarer Nationalities

		Burmese[a]	Filipinos[b]	Europeans[c]		
Nutrients	DRV[d]	M (±SD)	M (±SD)	M (±SD)	χ^2	p
Carbohydrate						
Amount (g)		303,1 (±76,7)	228,9 (±62,9)	188,2 (±88,4)	10,95	,004*
Fiber (g)	>30,0	**15,4** (±4,5)	**10,5** (±4,5)	**15,9** (±6,9)	7,06	,029*
Saccharose (g)	<36,6[e]	**40,6** (±28,5)	31,0 (±16,6)	35,4 (±30,0)	0,64	,728
Fat						
Amount (g)		82,8 (±22,4)	89,8 (±29,0)	108,2 (±39,7)	3,95	,139
Saturated Fatty Acid (% of E)[f]	7-10	**10,5** (± 3,2)	**13,8** (± 3,5)	**18,6** (± 4,5)	6,34	,042*
Eicosapentaenoic Acid (mg)	≥0,25	0,51 (±0,36)	0,32 (±0,22)	0,28 (±0,43)	7,39	,025*
Docosahexaenoic Acid (mg)	≥0,25	0,89 (±0,59)	0,78 (±0,45)	0,59 (±0,72)	3,91	,142
Cholesterol (mg)	<300,0	**578,8** (±241,1)	**715,7** (±183,2)	**640,2** (±283,4)	3,16	,206
Protein						
Amount (g)		106,9 (±21,7)	124,7 (±23,9)	106,2 (±40,7)	3,41	,182
Other						
Alcohol (g)	<20,0	2,4 (±4,3)	10,1 (±15,1)	9,0 (±14,0)	3,30	,192
Salt (g)	<5,0	**7,3** (±4,5)	**5,9** (±2,6)	**7,8** (±3,6)	1,58	,455
Total Water (ml)	≥1500	3537,7 (±1024,3)	2979,3 (±693,6)	2776,2 (±909,7)	3,95	,139

Note. N = 37. [a]n = 13. [b]n = 13. [c]n = 11. Means deviating from the DRV are in boldface. [d]DACH Reference Values (DGE et al., 2019). [e]Recommendation by The American Heart Association (2019). [f]Percentage of daily metabolizable energy intake. *p < 0,05. The test statistic was adjusted for ties.

Macronutrient intake:

Table 14 shows the most relevant results for macronutrients, alcohol, salt, and water from the *Ebispro 2011* nutrition software and the recommendations for the average intake of the DGE (2019) and the American Heart Association (2019).

Among all groups, the mean intake of fiber (M_B = 15,4; M_F = 10,5; M_E = 15,9 g) fell short compared to the DRV, while the mean intakes of saturated fatty acids (saturated FA; M_B = 10,5; M_F = 13,8; M_E = 18,6% of DMEI), cholesterol (M_B = 578,8; M_F = 715,7; M_E = 640,2 mg), and salt (M_B = 7,3; M_F = 5,9; M_E = 7,8 g) surpassed the recommendations. The average saccharose intake of Burmese seafarers (M_B = 40,6 g) exceeded the DRV. Moreover, the Kruskal-Wallis test indicated group differences in nutrient intakes for carbohydrate ($\chi^2(2)$ = 10,95; p = ,004), fiber ($\chi^2(2)$ = 7,06; p = ,029), saturated FA ($\chi^2(2)$ = 6,34; p = ,042) and Eicosapentaenoic Acid (EPA; $\chi^2(2)$ = 7,39; p = ,025).

Table 15. Post-hoc Dunn-Bonferroni-Tests and Standardized Regression Coefficients for Daily Macronutrient Intake of 3 Seafarer Nationalities

	Burmese x Filipinos[a]			Burmese x Europeans[b]			Filipinos x Europeans[c]		
Nutrients	z	|r|[d]	p	z	|r|[d]	p	z	|r|[d]	p
Carbohydrates (g)	-2,14	0,42	,098	-3,24	0,66	,004**	-1,19	0,24	,698
Fiber (g)	-2,36	0,46	,055	-0,48	0,01	1,000	2,21	0,45	,082
Saturated FA (% of E)[e]	1,42	0,28	,465	2,50	0,51	,037*	1,14	0,23	,760
EPA (mg)	-1,37	0,27	,510	-2,72	0,55	,020*	-1,40	0,29	,481

Note. N = 37. [a]n = 26. [b]n = 24. [c]n = 24. [d]Standardized Regression Coefficients as an Effect size index. [e]Percentage of daily metabolizable energy intake. ***p < ,001. **p < ,01. *p < ,05.

Post-hoc Dunn-Bonferroni-Tests showed that carbohydrate levels (z = -3,24; |r| = 0,66; p = ,004) and EPA (z = -2,72; |r| = 0,55; p = ,020) were significantly increased and saturated FA (z = 2,50; |r| = 0,51; p = ,037) lower for Burmese than for European seafarers and the following standardized regression coefficients resulted in large effect sizes.

Figure 6 illustrates the recommended and the measured average composition of macronutrients in the DMEI. For the total study population, neither carbohydrate (M = 42,1%), fat (M = 35,4%), nor protein (M = 20,1%) were within the recommended range. Furthermore, alcohol (M = 2,5%) needed to be noticed as an additional relevant source of energy among seafarers.

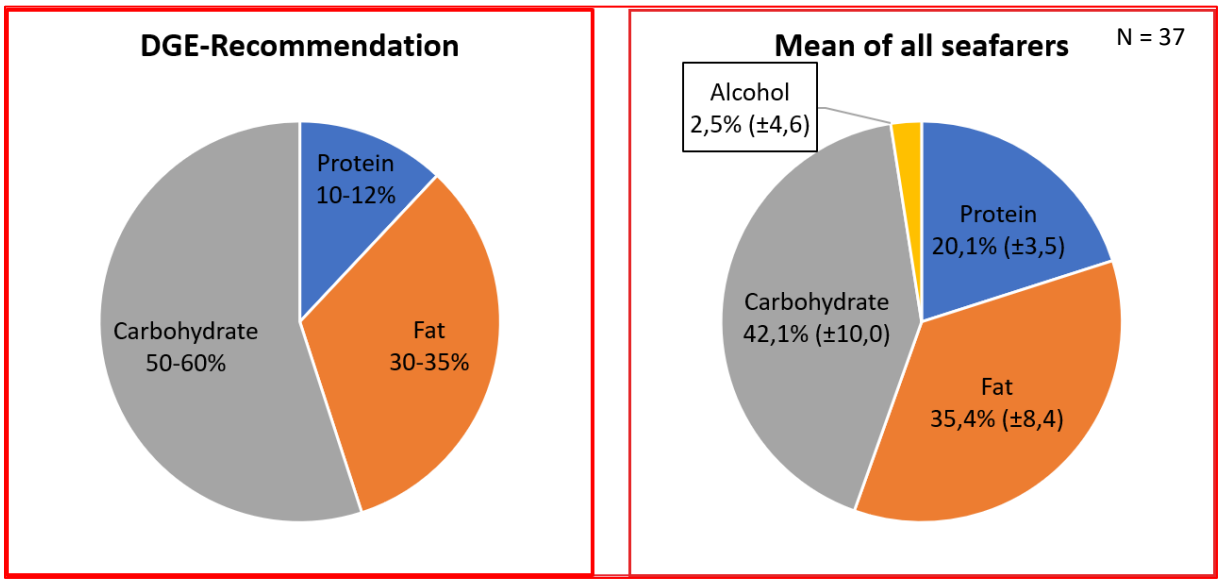

Figure 6. Compositions of Average Macronutrient Intake in Total Energy Intake

The division of data into groups, as shown in Figure 7, displays that the proportion of macronutrients in total energy varied by nationality. In regards to the recommendations of the DGE et al. (2019), Burmese seafarers received 50,9% of their energy from carbohydrates and 30,2% from fats and thus fulfilled reference values. In comparison, Philippine and European seafarers did not meet recommendations as proportions of carbohydrates were lower for both and fats higher among Europeans, respectively. These differences among groups for carbohydrate (χ^2 = 17,66; p < ,001), fat (χ^2 = 14,26; p = ,001) and protein (χ^2 = 8,07; p = ,018) levels were also indicated by Kruskal-Wallis Test.

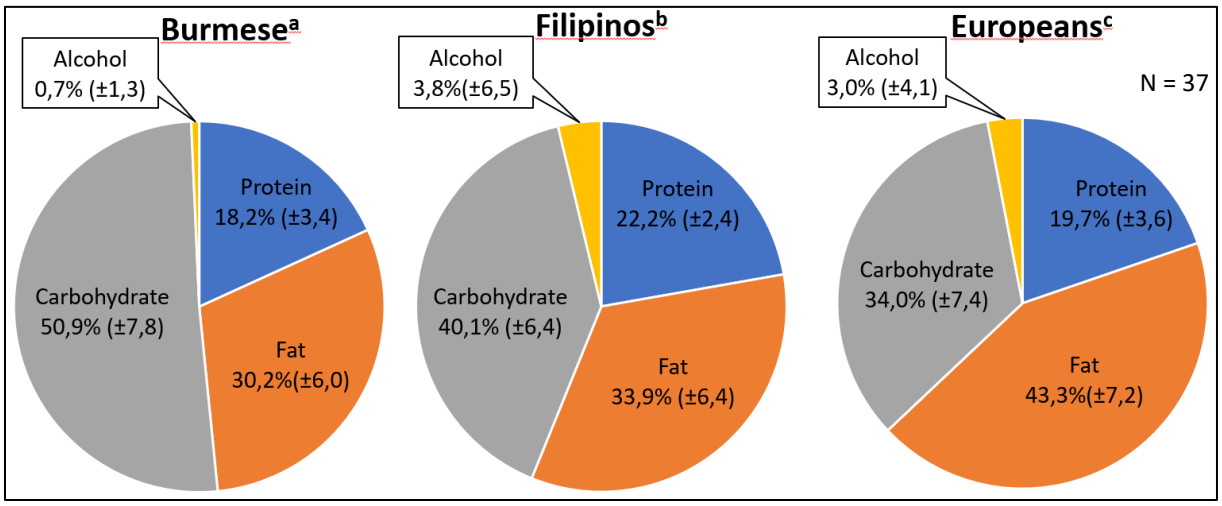

Figure 7. Comparison of the Compositions of Average Macronutrient Intake in Total Energy Intake
[a]n = 13. [b]n = 13. [c]n = 11.

The post-hoc Dunn-Bonferroni-Tests showed that Burmese consumed significantly greater percentages of carbohydrates on the DMEI than Filipinos (z = -2,57; |r| = 0,5; p = ,030) and Europeans (z = -4,15; |r| = 0,85; p < ,001), whereas the percentage of fat on the DMEI, was significantly greater among Europeans compared to Burmese (z = 3,69; |r| = 0,75; p = ,001) and Filipinos (z = 2,67; |r| = 0,55; p = ,023). The Philippine seafarers' percentage of protein on the DMEI was significantly greater than that of Burmese seafarers (z = 2,81; |r| = 0,55; p = ,015). All differences found were large effects (see Table 16).

Table 16. Post-hoc Dunn-Bonferroni-Tests and Standardized Regression Coefficients for Daily Macronutrient Intake of 3 Seafarer Nationalities

	Burmese x Filipinos[a]			Burmese x Europeans[b]			Filipinos x Europeans[c]		
Nutrients	z	|r|[d]	p	z	|r|[d]	p	z	|r|[d]	p
Carbohydrate (% of E)[e]	-2,57	0,50	,030*	-4,15	0,85	< ,001***	-1,69	0,34	,276
Fat (% of E)[e]	1,07	0,21	,855	3,69	0,75	,001**	2,67	0,55	,023*
Protein (% of E)[e]	2,81	0,55	,015*	0,97	0,20	1,000	-1,72	0,35	,254

Note. N = 37. [a]n = 26. [b]n = 24. [c]n = 24. [d]Standardized Regression Coefficients as an Effect size index. [e]Percentage of daily metabolizable energy intake. ***p < ,001. **p < ,01. *p < ,05.

Micronutrient intake:

Table 17 shows the detailed results for the micronutrient intake of the different seafarer nationalities as well as the dietary reference values by DGE et al. (2019).

Among all groups, the average vitamin intake was below the recommended levels for folate (M_B = 241,6; M_F = 218,1; M_E = 252,2 µg), vitamin C (M_B = 91,9; M_F = 71,3; M_E = 105,1 mg), vitamin D (M_B = 5,8; M_F = 16,1; M_E = 4,7 µg), and vitamin E (M_B = 9,2; M_F = 9,0; M_E = 9,2 mg). The vitamin A intake for Burmese and Filipinos (M_B = 692,7; M_F = 997,1 µg) and the vitamin B_1 intake for Burmese (M_B = 1,1 mg) did not reach the DRV.

Regarding the average mineral intake, none of the groups met the minimum DRV for potassium (M_B = 2766,3; M_F = 2623,0; M_E = 3111,4 mg), calcium (M_B = 509,8; M_F = 515,1; M_E = 703,4 mg), and iodine (M_B = 72,5; M_F = 68,5; M_E = 74,8 µg), but all groups surpassed the upper limit for sodium (M_B = 3484,0; M_F = 2535,2; M_E = 3338,3 mg).

Moreover, group differences in nutrient intake were indicated for vitamin A (χ^2 = 10,69; p = ,005), vitamin B_1 (χ^2 = 12,29; p = ,002), vitamin B_{12} (χ^2 = 7,28; p = ,026), vitamin C (χ^2 = 7,54; p = ,023), vitamin D (χ^2 = 7,20; p = ,027), vitamin K (χ^2 = 16,76; p < ,001) , and calcium (χ^2 = 7,27; p = ,026).

Table 17. Group Comparison: Means, Standard Deviations, and Results of the Kruskal-Wallis-Test for Daily Micronutrient Intake of 3 Seafarer Nationalities

Nutrients	DRV[d]	Burmese[a] M (±SD)	Filipinos[b] M (±SD)	Europeans[c] M (±SD)	χ^2	p
Vitamins						
Vitamin A (µg)	1000	**692,7** (±280,6)	**997,1** (±319,2)	1294,1 (±652,3)	10,69	,005*
Vitamin B1 (mg)	1,2	**1,1** (±0,3)	1,8 (±0,6)	1,8 (±0,8)	12,29	,002*
Vitamin B2 (mg)	1,3	1,4 (±0,4)	1,8 (±0,5)	1,8 (±0,7)	4,15	,126
Vitamin B6 (mg)	1,5	2,0 (±0,6)	2,0 (±0,4)	2,1 (±1,0)	< 0,01	,999
Folate (µg)	300	**241,6** (±59,7)	**218,1** (±49,2)	**252,2** (±94,1)	1,31	,520
Vitamin B12 (µg)	3	9,3 (±4,7)	11,3 (±3,3)	6,4 (±4,9)	7,28	,026*
Vitamin C (mg)	110	**91,9** (±27,6)	**71,3** (±27,6)	**105,1** (±43,2)	7,54	,023*
Vitamin D (µg)	20	**5,8** (±4,5)	**16,1** (±12,7)	**4,7** (±3,5)	7,20	,027*
Vitamin E (mg)	13-15	**9,2** (±3,3)	**9,0** (±2,8)	**9,2** (±4,8)	0,14	,993
Vitamin K (µg)	70	210,0 (±87,8)	73,0 (±42,9)	110,2 (±63,3)	16,76	<,001*
Minerals						
Sodium (mg)[e]	1500	3484,0 (±1729,4)	2535,2 (±1108,1)	3338,3 (±1570,2)	1,90	,387
Potassium (mg)	4000	**2766,3** (±610,8)	**2623,0** (±524,4)	**3111,4** (±1027,3)	3,38	,185
Calcium (mg)	1000	**509,8** (±101,7)	**515,1** (±192,5)	**703,4** (±205,4)	7,27	,026*
Magnesium (mg)	350	359,2 (±71,5)	365,6 (±66,2)	**346,7** (±117,7)	0,27	,874
Phosphorus (mg)	700	1460,8 (±232,0)	1481,0 (±260,8)	1405,3 (±483,0)	0,26	,876
Iron (mg)	10	12,6 (±2,8)	13,8 (±3,1)	14,3 (±5,0)	0,96	,620
Iodine (µg)	200	**72,5** (±36,8)	**68,5** (±22,2)	**74,8** (±24,6)	0,56	,758
Zinc (mg)	10	13,0 (±2,8)	16,8 (±4,0)	15,7 (±5,9)	5,25	,072

Note. N = 37. [a]n = 13. [b]n = 13. [c]n = 11. Means below the DRV are in boldface. [d]DACH Reference Values (DGE et al., 2019). [e]Upper Limit of Sodium equals 2300mg (DGE et al., 2019).
*p < 0,05. The test statistic was adjusted for ties.

Table 18 displays the results of the post-hoc Dunn-Bonferroni-Tests and standardized regression coefficients for the daily micronutrient intake. Two significant results were found for the groups of Burmese and Filipinos, four for Burmese and Europeans and three among Filipinos and Europeans.

Table 18. Post-hoc Dunn-Bonferroni-Tests and Standardized Regression Coefficients for Daily Micronutrient Intake of 3 Seafarer Nationalities

	Burmese x Filipinos[a]			Burmese x Europeans[b]			Filipinos x Europeans[c]		
Nutrients	z	|r|[d]	p	z	|r|[d]	p	z	|r|[d]	p
Vitamin A (µg)	2,19	0,43	,085	3,18	0,65	,004**	1,08	0,22	,840
Vitamin B1 (mg)	3,31	0,65	,003**	2,61	0,53	,027*	-0,56	0,11	1,000
Vitamin B12 (µg)	1,28	0,25	,604	-1,48	0,30	,421	-2,70	0,55	,021*
Vitamin C (mg)	-1,96	0,38	,151	0,76	0,15	1,000	2,63	0,54	,026*
Vitamin D (µg)	2,16	0,42	,093	-0,37	0,08	1,000	-2,43	0,50	,045*
Vitamin K (µg)	-4,06	0,80	<,001***	-2,41	0,49	,048*	1,48	0,30	,420
Calcium (mg)	0,16	0,03	1,000	2,44	0,50	,044*	2,29	0,47	,067

Note. N = 37. [a]n = 26. [b]n = 24. [c]n = 24. [d]Standardized Regression Coefficients as an Effect size index. ***p < ,001. **p < ,01. *p < ,05.

<u>Supplementation:</u>

Philippine (30%), European (40%) and Burmese seafarers (46%) stated to use supplements. Figure 8 shows vitamins and multivitamins most commonly used among nationalities.

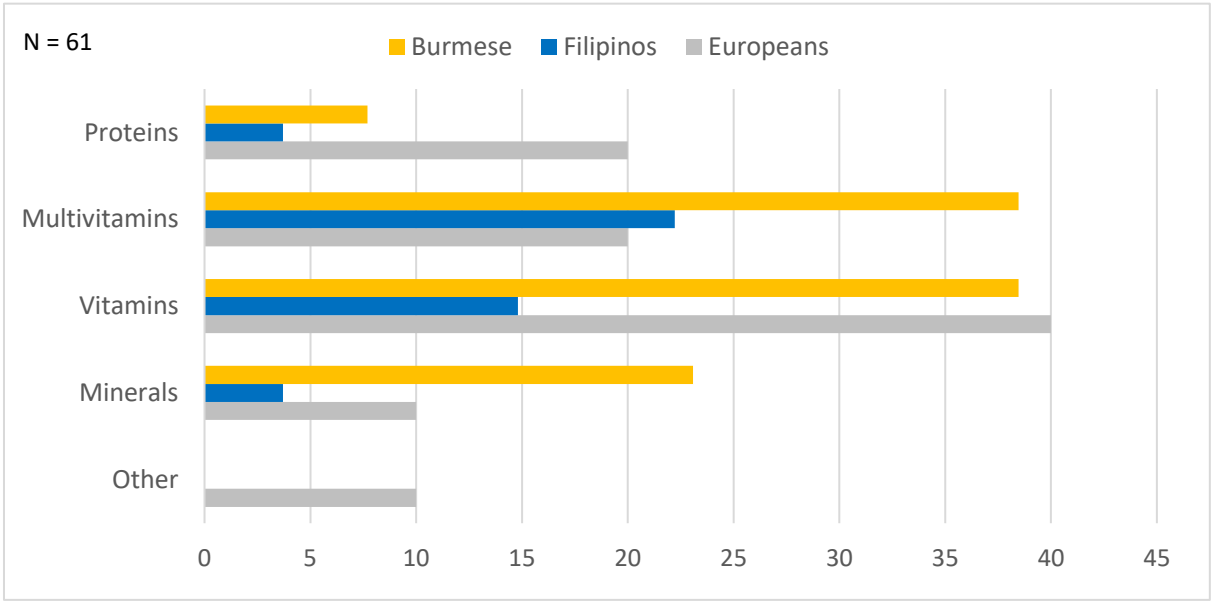

Figure 8. Type of Supplements Used as a Percentage of the Groups
Question: Which type of supplement(s) do you use? Chi-Square was not significant.

5.4 Differences between Seafarers' Dietary Intake at Home and Sea

Onboard the container vessels visited, three warm meals were offered every day: breakfast, lunch, and dinner. However, not every seafarer indicated to attend all three warm meals as they replied to have had M(SD) = 2,86 (±0,58). Compared to onboard, between 45 to 56% of the seafarers stated to have the same amount of meals in their home country, while the reply options "less" and "more" received almost the same amounts of votes (see Figure 9).

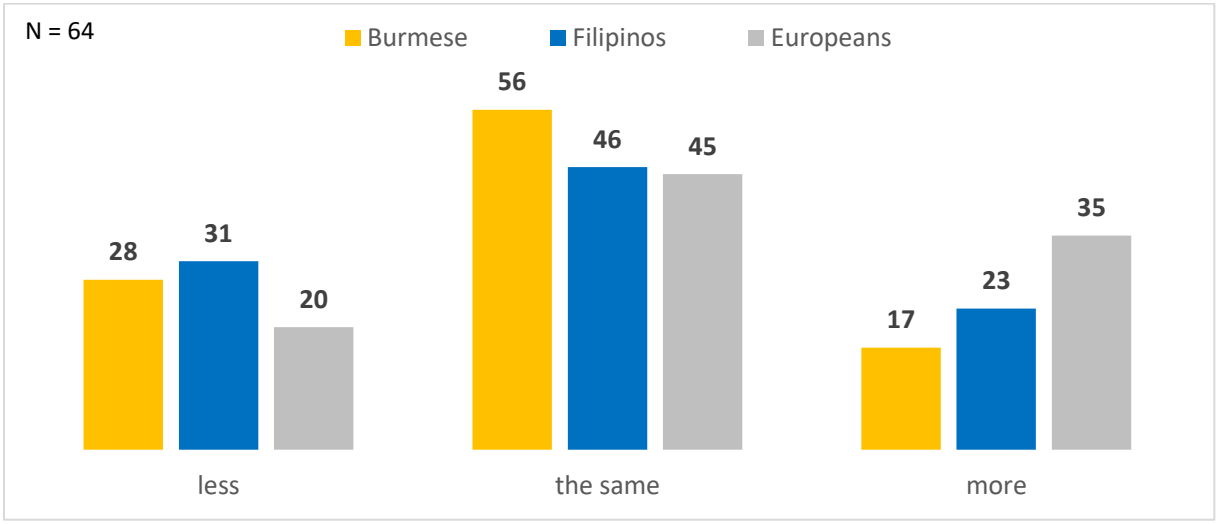

Figure 9. Amount of Meals Consumed at Home in Comparison to on Board
Question: Compared to onboard, the amount of meals I have a day when I am in my home country is __. Neither t-test for the study population nor Kruskal-Wallis for group comparison showed any significant results.

<u>Frequencies of seafarers' food and drink consumption at their home compared to at sea:</u>

Table 19 shows the results to the question of how frequently seafarers ate foods and drinks when they were in their home country compared to onboard (test value 0). Twelve of 16 foods and 7 of 10 drinks were consumed in a significantly different frequency at home.

The results for vegetables ($t(61) = 12,13$; $p < ,001$; $d = 1,54$), fruits ($t(63) = 6,75$; $p < ,001$; $d = 0,84$), sausage ($t(55) = -7,20$; $p < ,001$; $d = 0,96$) and fish ($t(61) = 6,83$; $p < ,001$; $d = 0,87$) were significant at the 0,001 level with large effect sizes each. However, while seafarers stated to consume vegetables, fruits and fish more often, sausage was eaten less when at home. Additionally, significant negative results for noodles ($t(58) = -5,75$; $p < ,001$; $d = 0,75$) and chips & salted nuts ($t(54) = -4,51$; $p < ,001$; $d = 0,61$) with a medium effect size indicated fewer consumption of these foods when seafarers were ashore.

Table 19. Means, Standard Deviations, Cohen's d and Results of One-Sample-t-Tests[a] (test value=0)[b] for the Frequencies of Seafarers' Food and Drink Consumption at their Home Country Compared to at Sea

Foods and Drinks	M	SD	|d|	t	df	p
Foods						
Bread	-0,50	1,19	0,42	-3,14	55	,003**
Rice	-0,13	1,32	0,10	-0,77	61	,446
Noodles	-0,92	1,22	0,75	-5,75	58	< ,001***
Potato	-0,54	1,28	0,42	-3,26	58	,002**
Vegetables	1,29	0,84	**1,54**	12,13	61	< ,001***
Salad	0,38	1,38	0,27	2,13	60	,037
Fruits	0,94	1,11	**0,84**	6,75	63	< ,001***
Milk & Milk Products	0,16	1,13	0,14	1,12	62	,267
Cheese	-0,53	1,39	0,38	-2,82	54	,007**
Meat	-0,27	1,13	0,24	-1,88	63	,065
Sausage	-0,89	0,93	**0,96**	-7,20	55	< ,001***
Fish	0,97	1,12	**0,87**	6,83	61	< ,001***
Egg	-0,41	1,15	0,36	-2,86	62	,006**
Cake, Sweets, Cookies & Confectionery	-0,56	1,26	0,44	-3,40	58	,001**
Chips & Salted Nuts	-0,69	1,14	0,61	-4,51	54	< ,001***
Drinks						
Water	0,36	1,17	0,31	2,45	63	,017*
Coffee	-0,69	1,06	0,65	-4,94	57	< ,001***
Tea	-0,20	1,12	0,18	-1,31	55	,194
Cola	-1,12	0,88	**1,27**	-8,33	42	< ,001***
Lemonade	-0,39	1,15	0,34	-2,43	50	,019*
Ice tea	-0,43	1,07	0,41	-2,76	45	,008**
Sweetened tea	-0,76	1,03	0,74	-4,59	37	< ,001***
Fruit juice	0,02	1,21	0,01	0,11	61	,917
Beer/wine	-0,18	1,03	0,17	-1,30	55	,199
Spirit	-0,64	1,07	0,60	-4,08	46	< ,001***

Note. N = 64. Question: Compared to onboard, how frequently do you eat the following foods, when you are in your home country? [a]Normal distribution was expected regarding the central limit value principle (Bortz, 2004). [b]The value 0 is equivalent to the food and drink consumption at sea. Large effect sizes by Cohen (|d|> 0,8) are in boldface. ***p < ,001. **p < ,01. *p < ,05.

Four drinks showed significant negative results at the 0,001 level with a large effect for cola (t(42) = -8,33; p < ,001; d = 1,27) and medium effects for coffee (t(57) = -4,94; p < ,001; d = 0,65), sweetened tea (t(37) = -4,59; p < ,001; d = 0,74) and spirit (t(46) = -4,08; p < ,001; d = 0,60). Group differences regarding food and drink consumption at home were analyzed with Kruskal-Wallis (see Table 20) and post-hoc Dunn-Bonferroni-Tests (see Table 21).

Table 20. Group Comparison: Means, Standard Deviations, and Results of the Kruskal-Wallis-Test for the Frequencies of 3 Seafarer Nationalities' Food and Drink Consumption at Home Country Compared to at Sea

	Burmese[a]			Filipinos[b]			Europeans[c]				
Foods and Drinks	n	M	SD	n	M	SD	n	M	SD	χ^2	p
Foods											
Bread	13	-1,31	0,72	25	-0,72	1,00	18	0,39	1,11	16,15	< ,001*
Rice	18	0,72	1,10	25	0,08	1,13	19	-1,21	0,95	21,71	< ,001*
Noodles	17	-0,53	1,24	24	-1,38	0,99	18	-0,67	1,25	6,88	,032*
Potato	18	-0,39	1,11	21	-1,19	0,91	20	0,00	1,41	8,83	,012*
Vegetables	18	1,44	0,68	25	1,40	0,69	19	1,00	1,03	2,32	,314
Salad	17	0,94	0,94	24	-0,29	1,37	20	0,70	1,35	9,26	,010*
Fruits	18	1,00	1,00	26	0,85	1,17	20	1,00	1,10	0,23	,891
Milk & Milk Products	18	0,17	0,96	25	-0,44	0,98	20	0,90	0,94	15,74	< ,001*
Cheese	12	-1,50	0,65	24	-1,21	0,71	19	0,95	1,10	31,31	< ,001*
Meat	18	0,06	1,13	26	-0,62	1,00	20	-0,10	1,14	3,88	,144
Sausage	13	-1,31	0,82	26	-1,08	0,67	17	-0,29	1,02	9,50	,009*
Fish	18	1,00	1,05	26	1,35	0,87	18	0,39	1,21	7,58	,023*
Egg	17	0,29	1,07	26	-0,69	0,99	20	-0,65	1,11	9,06	,011*
Cake, Sweets, Cookies & Confectionery	17	-0,82	1,10	25	-1,28	0,83	17	0,76	0,81	26,31	< ,001*
Chips & Salted Nuts	18	-0,44	1,12	23	-1,17	0,87	14	-0,21	1,21	7,27	,026*
Drinks											
Water	18	0,28	1,10	26	0,92	1,21	20	-0,30	0,71	14,98	,001*
Coffee	17	-0,76	0,94	23	-0,96	1,04	18	-0,28	1,04	4,40	,111
Tea	14	0,29	1,22	22	-0,95	0,88	20	0,30	0,71	17,45	< ,001*
Cola	11	-1,18	0,72	21	-1,24	0,75	11	-0,82	1,11	0,87	,648
Lemonade	14	-0,36	1,04	26	-0,46	1,08	11	-0,27	1,35	0,10	,953
Ice tea	12	-0,75	0,72	26	-0,54	1,08	8	0,38	0,99	6,62	,036*
Sweetened tea	12	-0,50	1,12	19	-1,11	0,79	7	-0,29	1,03	4,05	,132
Fruit juice	18	-0,06	1,27	25	-0,32	1,16	19	0,53	0,99	4,86	,088
Beer/Wine	11	0,00	1,35	26	-0,69	0,67	19	0,42	0,82	14,38	,001*
Spirit	12	-0,50	1,04	24	-1,17	0,80	11	0,36	0,77	15,94	< ,001*

Note. N=64. [a]n = 18. [b]n = 26. [c]n = 20. Question: Compared to onboard, how frequently do you eat the following foods, when you are in your home country? The value 0 is equivalent to the food and drink consumption at sea. *p < 0,05.

The group comparisons of food resulted in three significant differences between Burmese and Filipinos, six between Burmese and Europeans and ten between Filipinos and Europeans with medium or large effect sizes. Five findings for differences were similar between Europeans and both Asian groups. Europeans consumed more bread (B x E: z = 3,88; r = 0,70; p < ,001; F x E: z = 2,83; r = 0,43; p = ,014), cheese (B x E: z = 4,79; r = 0,86; p < ,001; F x E: z = 4,79; r = 0,73; p < ,001), sausage (B x E: z = 2,87; r = 0,52; p = ,013; F x E: z = 2,44; r = 0,37; p = ,044), and cake, sweets, cookies & confectionery (B x E: z = 3,52; r = 0,60; p = ,001; F x E: z = 5,05; r = 0,78; p < ,001), as well as less rice (B x E: z = -4,53; r = 0,74; p < ,001; F x E: z = -3,31; r = 0,50; p = ,003) when in their home country compared to Burmese and Philippine seafarers. While for bread, rice, cheese, and cake, sweets, cookies & confectionery the values for the European group expressed into the different directions than for the Burmese and Philippine group, all results showed a lower consumption for sausage when at home.

Table 21. Post-hoc Dunn-Bonferroni-Tests and Standardized Regression Coefficients for Frequencies of Seafarers' Food and Drink Consumption at their Home Country Compared to at Sea

	Burmese x Filipinos[a]			Burmese x Europeans[b]			Filipinos x Europeans[c]		
Food & Drink	z	|r|[d]	p	z	|r|[d]	p	z	|r|[d]	p
Foods									
Bread	1,57	0,25	,352	3,88	0,70	< ,001***	2,83	0,43	,014*
Rice	-1,56	0,24	,357	-4,53	0,74	< ,001***	-3,31	0,50	,003**
Noodles	-2,40	0,37	,050	-0,42	0,07	1,000	1,98	0,31	,144
Potato	-2,09	0,33	,111	0,68	0,11	1,000	2,85	0,45	,013*
Salad	-2,71	0,42	,020*	-0,37	0,06	1,000	2,43	0,37	,046*
Milk[e]	-1,62	0,25	,318	2,12	0,34	,101	3,97	0,59	< ,001***
Cheese	0,84	0,14	1,000	4,79	0,86	< ,001***	4,79	0,73	< ,001***
Sausage	0,86	0,14	1,000	2,87	0,52	,013*	2,44	0,37	,044*
Fish	1,10	0,17	,809	-1,52	0,25	,388	-2,75	0,41	,018*
Egg	-2,77	0,42	,017*	-2,56	0,42	,032*	0,06	0,01	1,000
Cake[f]	-1,20	0,19	,686	3,52	0,60	,001**	5,05	0,78	< ,001***
Chips[g]	-2,05	0,32	,122	0,51	0,09	1,000	2,44	0,40	,044*
Drinks									
Water	1,83	0,28	,200	-1,81	0,29	,212	-3,86	0,57	< ,001***
Tea	-3,17	0,53	,005**	0,28	0,05	1,000	3,82	0,59	< ,001***
Ice tea	0,56	0,09	1,000	2,43	0,54	,045*	2,27	0,39	,070
Beer/wine	1,26	0,21	,627	-1,83	0,33	,203	3,75	0,56	,001**
Spirit	-1,61	0,27	,321	2,10	0,44	,106	3,98	0,67	< ,001***

Note. N = 64. [a]n = 44. [b]n = 38. [c]n = 46. [d]Standardized Regression Coefficients as an Effect size index. [e]Milk & Milk Products. [f]Cake, Sweets, Cookies & Confectionery. [g]Chips & Salted Nuts. The value 0 is equivalent to the food and drink consumption at sea. ***p < ,001. **p < ,01. *p < ,05.

Additionally, further statistically significant differences were found. Europeans ate more potato (F x E: z = 2,85; r = 0,45; p = ,013), chips & salted nuts (F x E: z = 2,44; r = 0,40; p = ,044), milk & milk products (F x E: z = 3,97; r = 0,59; p < ,001), and less fish (F x E: z = -2,75; r = 0,41; p = ,018) at home than Filipinos. Filipinos ate fewer salad compared to Burmese (B x F: z = -2,71; r = 0,42; p = ,020), and European seafarers (F x E: z = 2,43; r = 0,37; p = ,046). Moreover, Burmese replied to consume greater amounts of egg at home compared to at sea which differed significantly to the negative means for the Philippine (B x F: z = -2,77; r = 0,42; p = ,017) and European (B x E: z = -2,56; r = 0,42; p = ,032) groups.

The group comparison of drinks showed that Filipinos drank significantly less beer/wine (F x E: z = 3,75; r = 0,56; p = ,001) and spirit (F x E: z = 3,98; r = 0,67; p < ,001) and more water (F x E: z = -3,86; r = 0,57; p < ,001) at home than Europeans, as well as less tea compared to Burmese (B x F: z = -3,17; r = 0,53; p = ,005) and European seafarers (F x E: z = 3,82; r = 0,59; p < ,001). Furthermore, the results indicated that Burmese drank significantly less ice tea (B x E: z = 2,43; r = 0,54; p = ,045) than the European seafarers when they were at home compared to at sea.

5.5 Environmental Factors that Influence the Seafarers Eating Behavior at Sea

When asked for the availability of fresh fruits, salads, and vegetables on board, the Burmese (89%), Philippine (84%) and European (90%) seafarers answered with an agreement or slight agreement (see Figure 10).

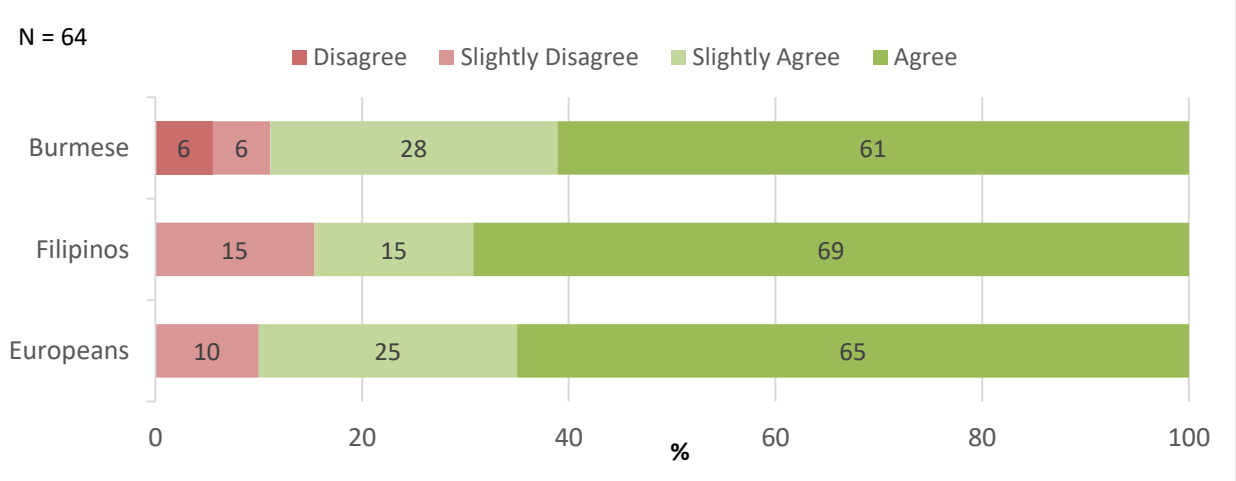

Figure 10. Availability of Fresh Fruits, Salads, and Vegetables as a Percentage of the Groups
Question: Are fresh fruits, salads, and vegetables available onboard? Kruskal-Wallis test indicated no significant differences for nationalities.

Furthermore, the Burmese (100%) and the majority of Filipinos (88%) agreed or slightly agreed that the cook took the different nationalities into account when preparing food, while 20% among the European seafarers disagreed or slightly disagreed to this statement (see Figure 11).

Figure 11. Consideration of the Different Nationalities by the Cook as a Percentage of the Groups
Question: Does the cook take different nationalities into account while preparing food onboard? Kruskal-Wallis test indicated no significant differences for nationalities.

When offshore, seafarers used sources other than the kitchen to access foods or drinks (Figure 12). About two-thirds of the seafarers bought foods (e.g., sweets, chips, salted nuts) or drinks (e.g., sugar-sweetened beverages, alcoholic beverages) in the ship store. Sixty-three percent of the Filipinos and 15% of the European seafarers stated that they sometimes ate fish that a fellow seafarer caught by fishing during free time. Other sources of foods and drinks named by the seafarers were foods they brought from home at the beginning of a contract or purchased from shore leaves.

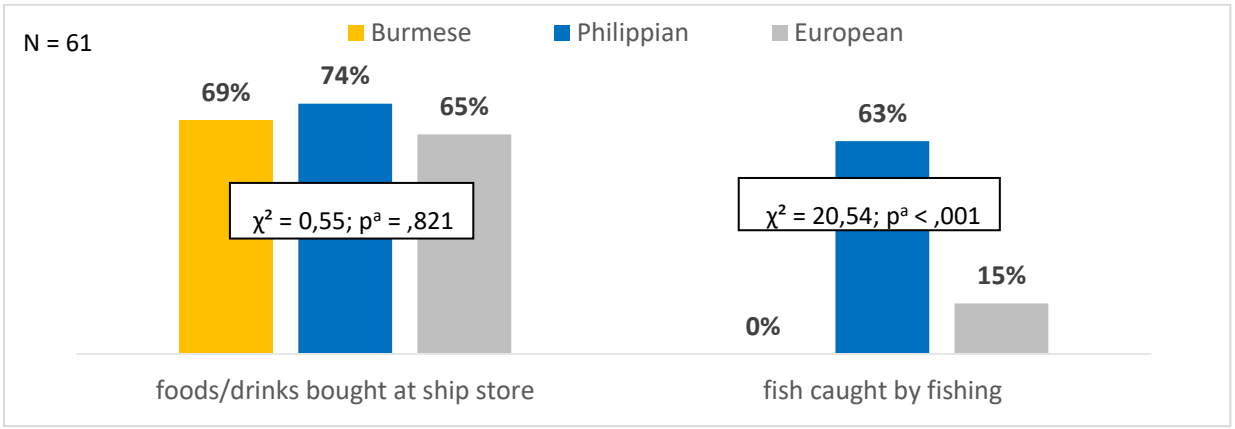

Figure 12. Further Sources for Foods and Drinks beside the Kitchen
Question: Did you sometimes eat food that was not supplied by the kitchen? ªFisher's Exact Test showed no significant results for group differences.

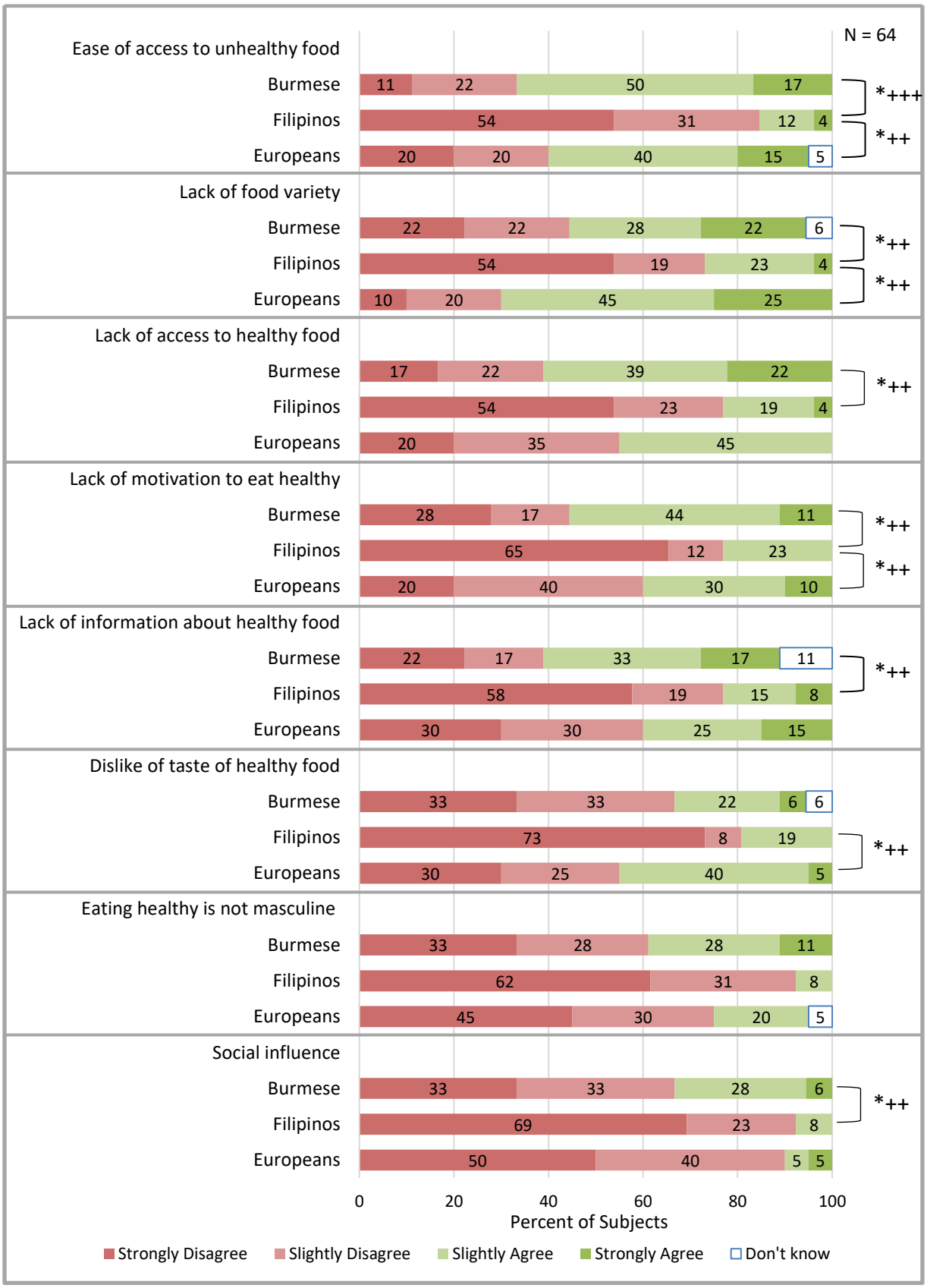

Figure 13. Barriers to Eating Healthy as a Percentage of Groups
Question: Listed are the reasons that people give to describe why they eat less healthy. Please read and rate each statement on how it applies to your situation on board. Group differences were tested with Kruskal-Wallis Tests with Post-hoc Dunn-Bonferroni-Tests. Parentheses indicate significant group differences. *p < 0,05. Effect sizes: $^{+}r < 0,3$. $^{++}r < 0,5$. $^{+++}r \geq 0,5$.

Barriers to eating healthy:

Figure 13 shows the seafarers' evaluation about reasons that people might have experienced as hindering to follow a healthy diet. Consistent barriers to healthy eating identified across all groups were the "ease of access to unhealthy food" (51%), "lack of food variety" (47%), and "lack of access to healthy food" (41%). However, a "lack of motivation to eat healthy" (34%) and a "lack of information about healthy food" (33%) were also consented by every third seafarer. Among all proposed barriers for eating healthy, Filipinos were always the ones with the lowest percentages of an agreement; most of their results differed significantly from Burmese and Europeans.

5.6 Individual Factors that Influence the Seafarers Eating Behavior at Sea

Satisfaction with food:

The majority of the crew indicated to be slightly satisfied or satisfied with the delicious look (80%), taste (77%), variety (77%), and quality (75%) of the food served onboard (see Figure 14). However, 1/4th of seafarers replied to be unsatisfied or slightly unsatisfied. There were no significant differences for satisfaction among the nationality groups.

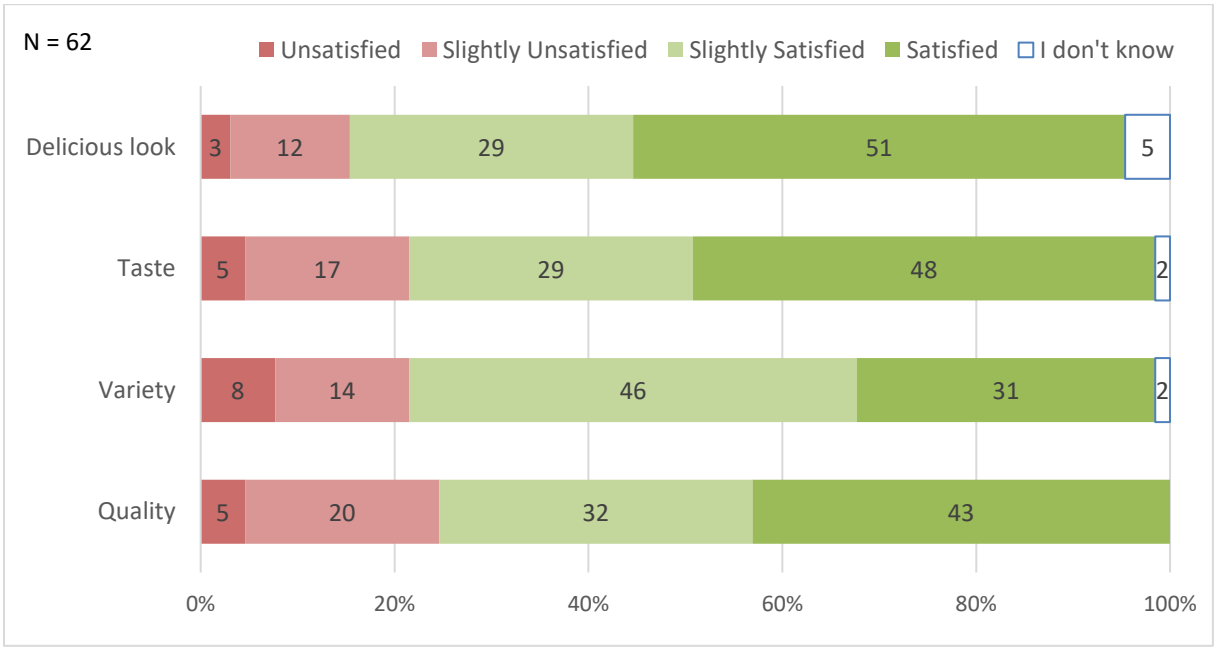

Figure 14. Satisfaction with Food on Board as a Percentage of the Study Population
Question: How satisfied are you (regarding the following aspects) with the food onboard? Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

Nevertheless, the results were not that clear when seafarers were asked, if they are more, evenly, or less satisfied with the same food aspects at home (see Figure 15). The delicious look by 55% and the taste of food by 50% was preferred at sea by the Europeans. The distribution of the votes "less" (χ^2 = 8,53; p = ,032) and "evenly" (χ^2 = 11,42; p = ,007) regarding taste of food was significantly different for Europeans compared to Burmese and Philippine seafarers. The majority of seafarers indicated that they were more or evenly satisfied with the variety and quality of foods in their home country. Regarding quality, not a single Filipino stated to be more satisfied with the food quality onboard, which also was statistically significant compared to Burmese and Europeans (χ^2 = 9,06; p = ,024).

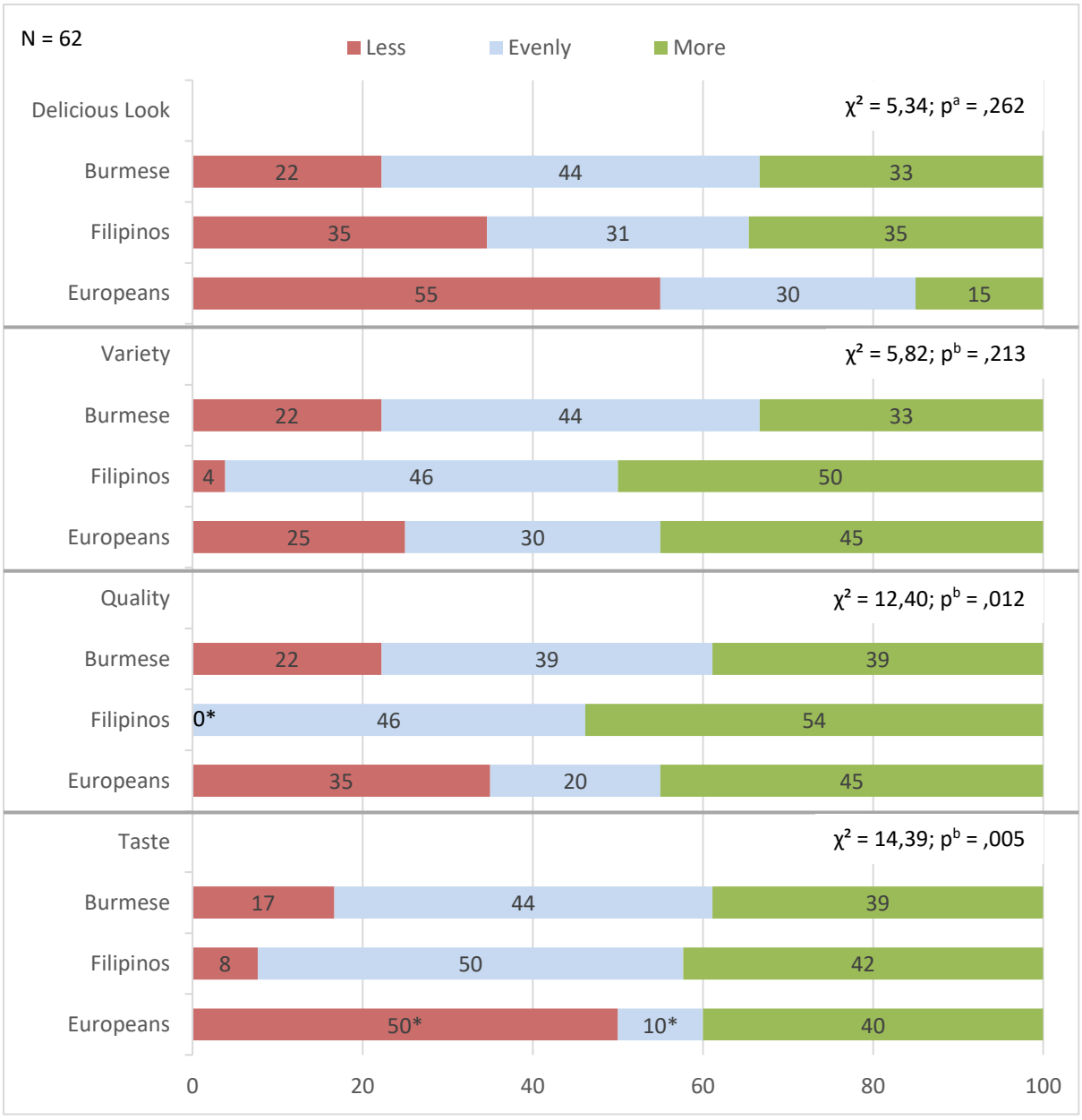

Figure 15. Satisfaction with Food at Home in Comparison to on Board
Question: Concerning the food aspects in my home country, I am satisfied _____. [a]Fisher's exact test. [b]Chi-square test. *p < 0,05 for post-hoc Bonferroni-Test.

However, referring to the importance of their well-being on board, 97% of the seafarers replied that food quality is important, or slightly important (see Figure 16).

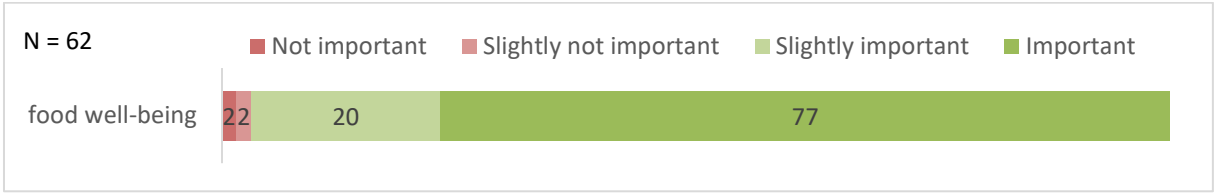

Figure 16. Importance of Food Quality for the Well-being as a Percentage of Study Population
Question: How important is the food quality for your well-being onboard? Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

Food Knowledge and Interest in Food:

Seafarers rated their knowledge about healthy food very diverse (see Figure 17). Half of the seafarers replied to have a low and the other half to have high knowledge about healthy food. Filipinos had significantly higher self-rated knowledge about healthy food compared to Burmese (B x F: z = 2,67; r = 0,40; p = ,007).

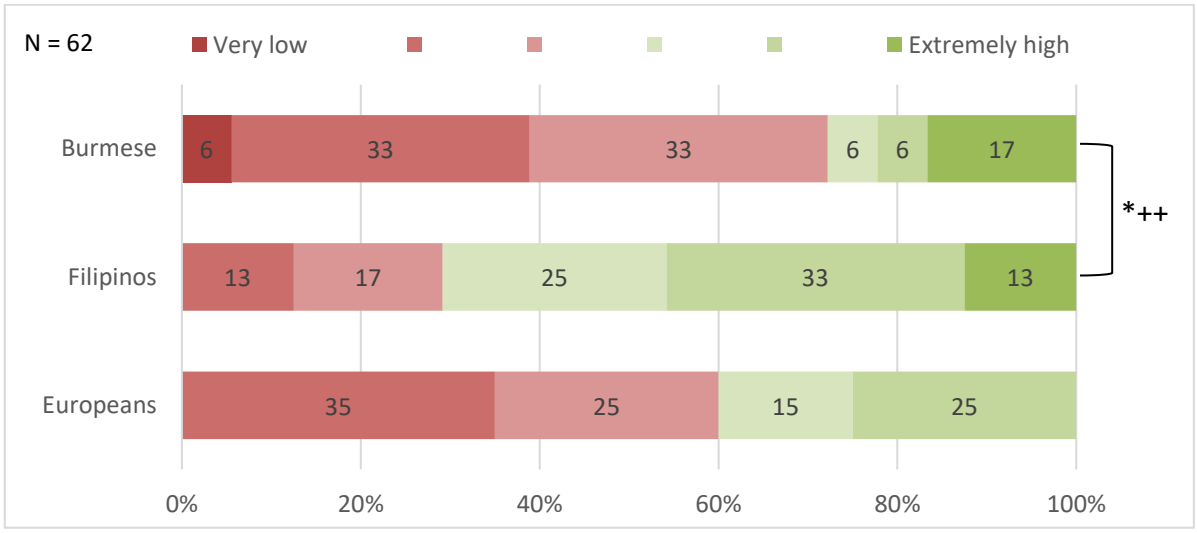

Figure 17. Knowledge about Healthy Food as a Percentage of Groups
Question: How would you rate your knowledge about healthy food? Group differences were tested with Kruskal-Wallis Tests with Post-hoc Dunn-Bonferroni-Tests. Parentheses indicate significant group differences. *p < 0,05. Effect sizes: $^{+}r < 0,3$. $^{++}r < 0,5$. $^{+++}r \geq 0,5$.

Even though about half of the seafarers stated to have a high knowledge about healthy food, 92% of the seafarers agreed or slightly agreed to be interested in further information about this topic (see Figure 18).

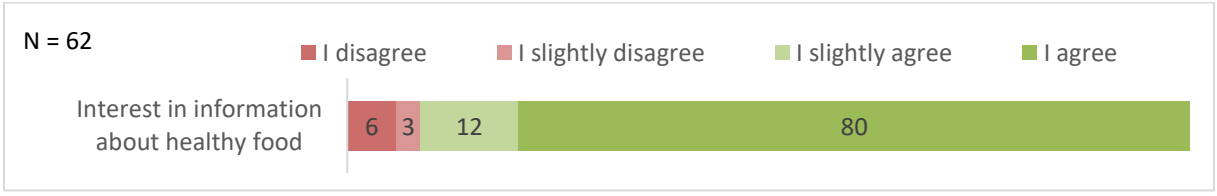

Figure 18. Interest in Information about Healthy Food as a Percentage of the Study Population
Question: Are you interested in more information about healthy food? Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

Below, the results of some questions that tested health knowledge are presented (Figure 19). The majority of seafarers correctly agreed and correctly disagreed respectively that "vegetables and fruits" (92%), "fish" (79%) and "drinking water" (80%) are part of a healthy diet while "cakes, cookies, and desserts" (77%) are not. However, in the latter case the replies significantly differed between Europeans to Burmese (B x E: z = 4,426; r = 0,72; p < ,001) and Philippine seafarers (F x E: z = 2,47; r = 0,36; p = ,040). While Europeans (95%) were aware that cake, cookies, and dessert were not part of a healthy diet, more than half of the Burmese seafarers responded opposite. Moreover, in two balanced results, 50% of respondents stated that a healthy diet contains a lot of meat, and 49% that it contains low quantities of lemonades.

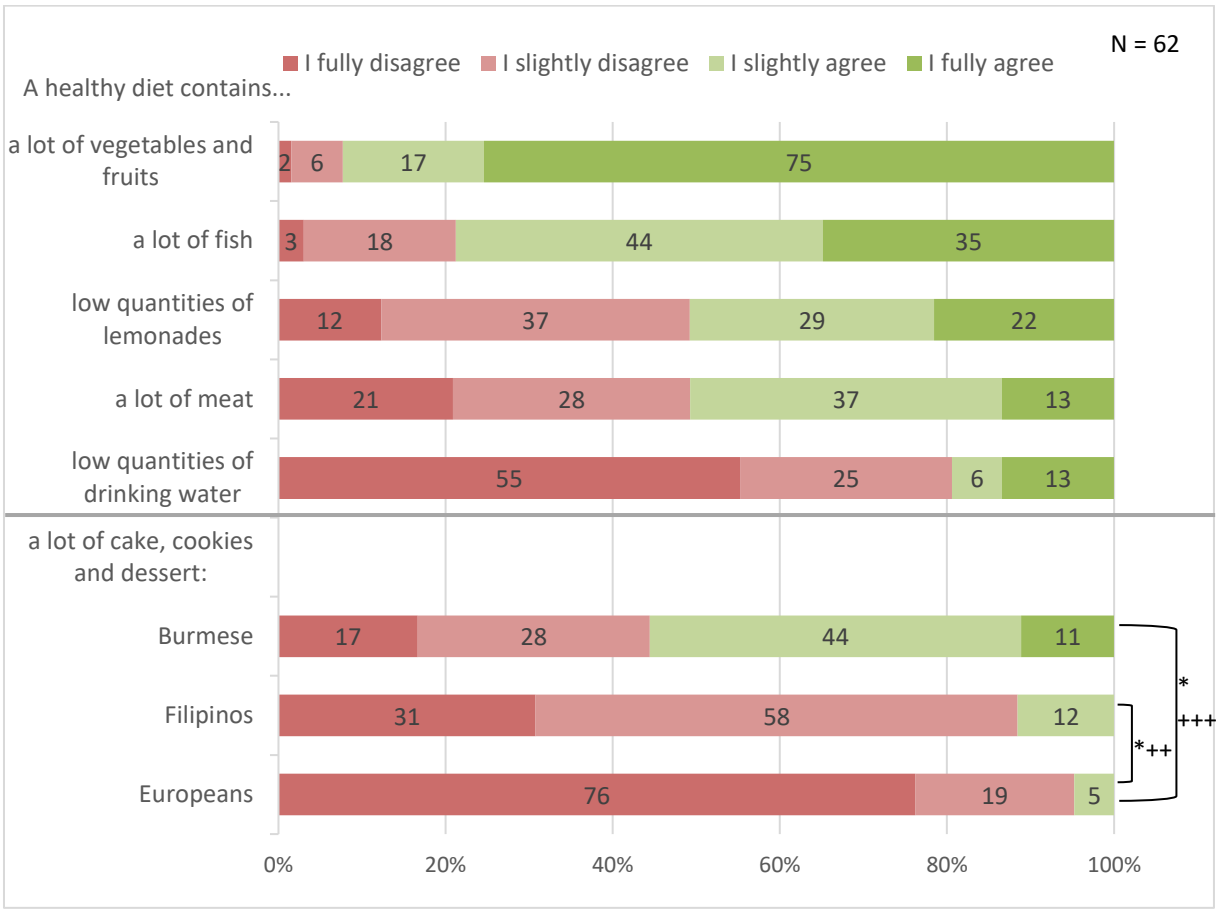

Figure 19. Beliefs about Components of a Healthy Diet as a Percentage of Study Population and Groups
Question: Please rate how much the following statements apply for a healthy diet! Group differences were tested with Kruskal-Wallis Tests with Post-hoc Dunn-Bonferroni-Tests. Parentheses indicate significant group differences. *p < 0,05. Effect sizes: $^{+}r < 0,3$. $^{++}r < 0,5$. $^{+++}r \geq 0,5$.

51% of the seafarers considered that vegetables should be a meal component for several times a day, while 20% think vegetables should be consumed daily (see Figure 20). Almost one fourth (22%) replied that they do not know the correct answer.

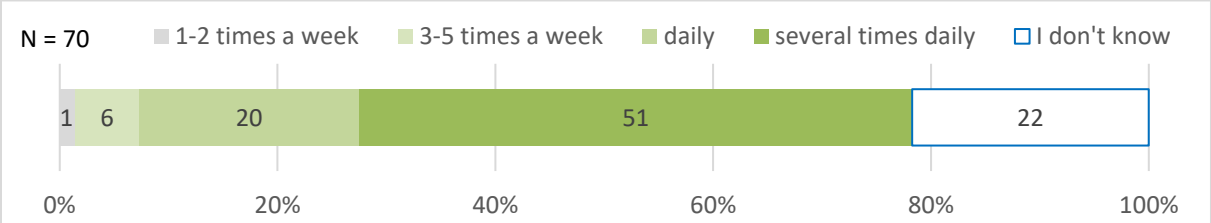

Figure 20. The Recommended Frequency of Vegetable Use for Meals regarding Seafarers as Percentages of Study Population

Question: How often do you think vegetables should be a component of meals? Presentation of results for the total study population as Fisher's Exact Test indicated no significant differences for nationalities.

In compliance with this, 49,3% of the seafarers answered the question regarding the composition of the healthy eating plate by recommendation (answer D) correctly (see Figure 21).

Figure 21. Composition of the Healthy Eating Plate

Question: Which of the following plates shows a healthy plate by recommendation? Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

The majority of the seafarers think that water (87%) and fruit juice (70%) were recommended as part of a healthy diet (Figure 22). Fewer seafarers voted for tea (38%), lemonade (29%),

coffee (20%), sweetened tea (9%), and ice tea (6%). Not a single seafarer named cola as part of a healthy diet.

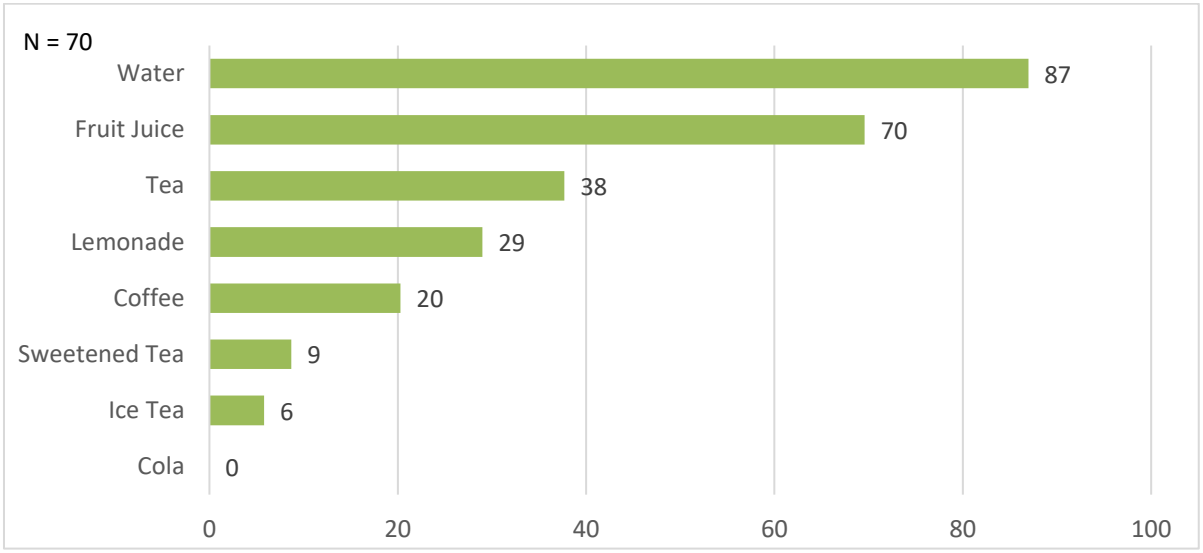

Figure 22. Beverages in a Healthy Diet regarding the Study Population as Percentages
Question: Which beverages are recommended as part of a healthy diet? Presentation of results for the total study population as Fisher's Exact Test indicated no significant differences for nationalities.

The seafarers were asked to rate statements about the effects of a healthy diet (Figure 23). All messages about healthy diets received a high agreement by the respondents with rates above 90%.

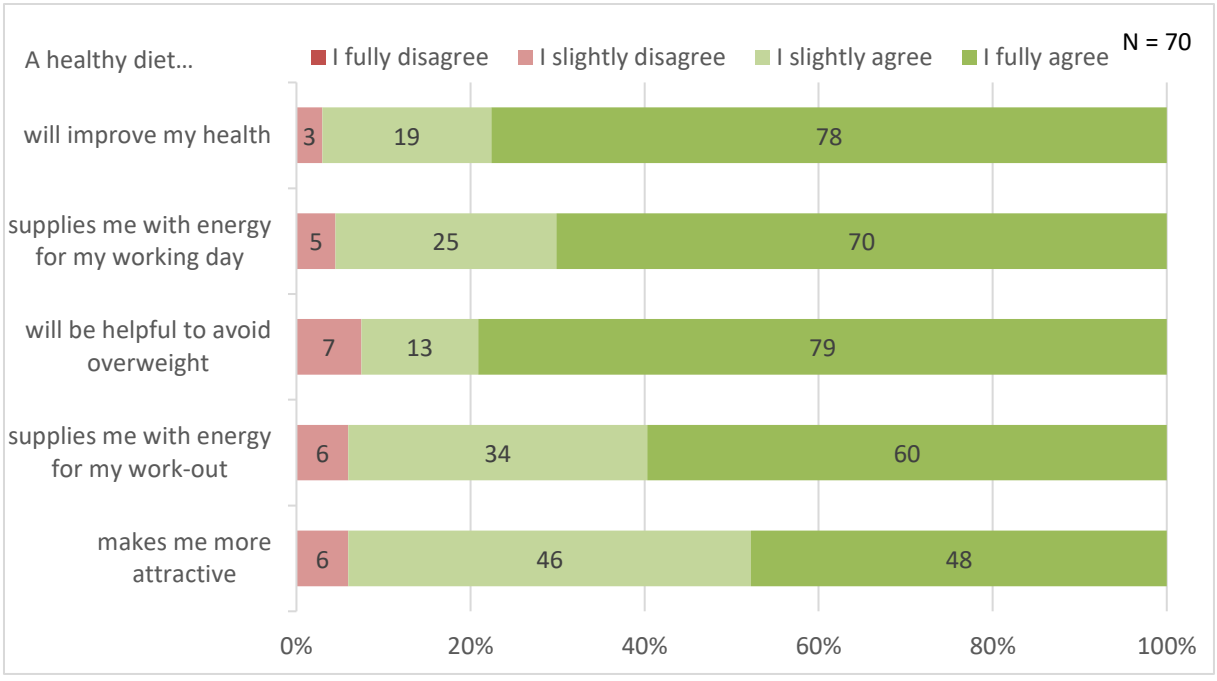

Figure 23. Beliefs about the Importance and Effects of a Healthy Diet as a Percentage of the Study Population
Question: Please rate how much the following statements apply for a healthy diet! Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

5.7 Seafarer Attitudes about Food, Intervention Measures, and Health Promotion Apps

Food preferences:

Ninety-one percent and eighty-eight percent of the seafarers stated that they would like the application of the proposed intervention measures onboard that were food labeling by nutritional value and having pre-cut fruits and vegetables served before the main dishes (see Figure 24).

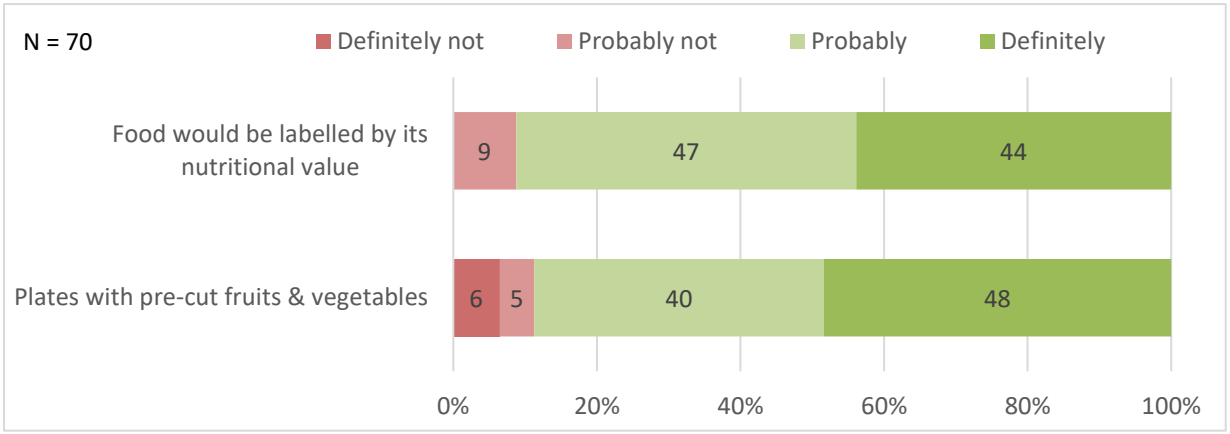

Figure 24. Seafarer Evaluation of Ideas for the Intervention as a Percentage of the Study Population
Question: Imagine the following measure would be applied onboard. Please rate, if you would like this kind of intervention? Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

Figure 25 shows the seafarers food preferences embedded in the description of two different ideas for interventions. Seventy-eight percent of the seafarers preferred the availability of fresh fruits and vegetables on five days of the week over the availability of sweet dessert on two days of the week. Further results were even more apparent when 89% of seafarers chose two meat-free meals a week, and 94% chose two meals containing fish a week over meals containing meat on every day of the week. Also, the classic barbecue which traditionally offers beef only was selected by 9% of the seafarers, while 91% preferred an extended barbeque with additional vegetable options.

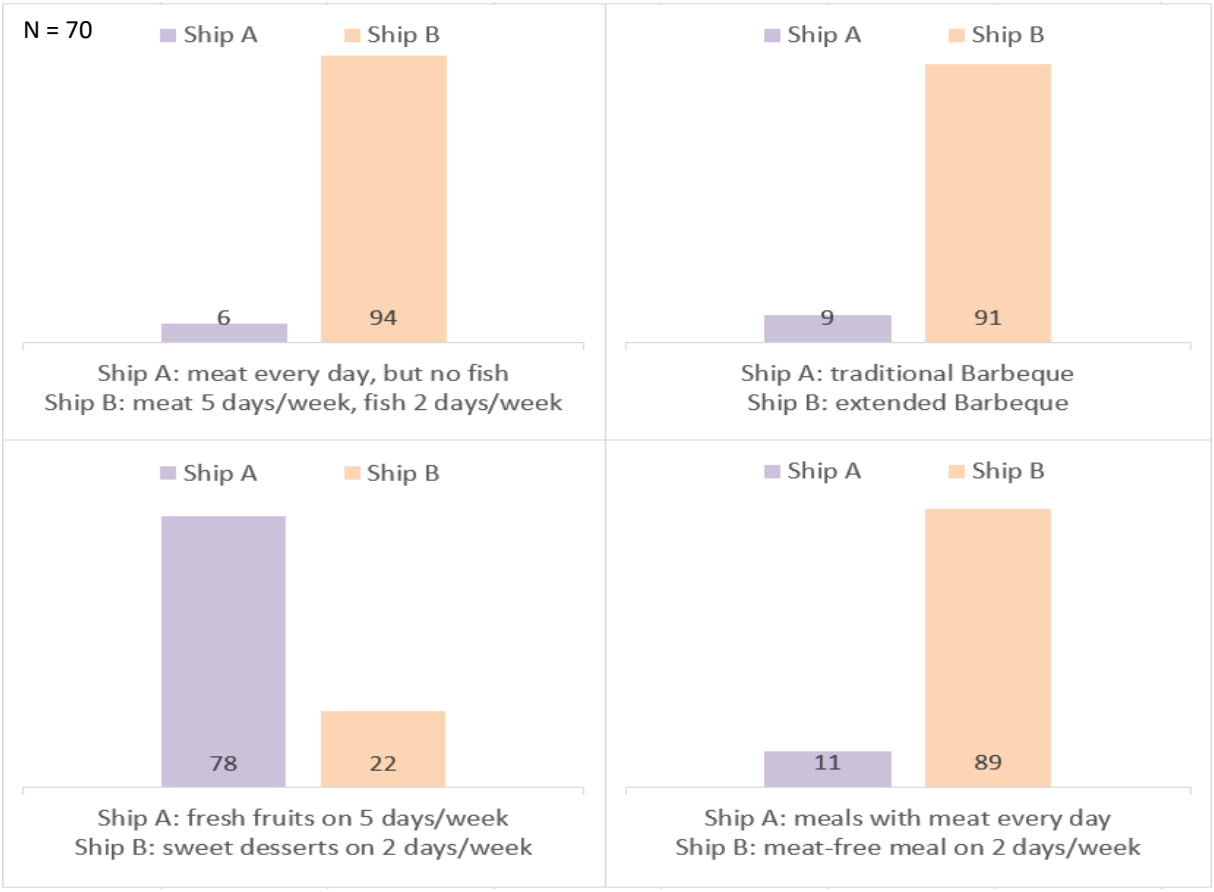

Figure 25. Seafarer Food Preferences as a Percentage of the Study Population
Question: Imagine two ships would receive a food intervention. Which option would you prefer? Presentation of results for the total study population as Fisher's Exact Test indicated no significant differences for nationalities.

<u>Importance of various aspects of the eating conditions:</u>

For the largest part, the eating conditions were rated to be slightly important at least (see Figure 26). In average, the distributions for "taste of food" and "nutritional value" were valued most important among all three groups.

Except for the taste of food, which was rated highest among Europeans, Filipinos valued all other aspects of the eating conditions more than compared with their Burmese and European counterparts. The answers for nutritional value of food (F x B: $z = 2{,}65$; $r = 0{,}40$; $p = {,}024$) were significantly more important for Filipinos than for Burmese and a pleasant environment significantly more important for Burmese (F x B: $z = 3{,}09$; $r = 0{,}47$; $p = {,}006$) and European seafarers (F x E: $z = 2{,}41$; $r = 0{,}35$; $p = {,}048$). Additionally, the Philippine seafarers rated the importance of social contacts while eating (F x E: $z = 3{,}14$; $r = 0{,}46$; $p = {,}005$) significantly greater compared to the Europeans. All significant results showed medium effect sizes.

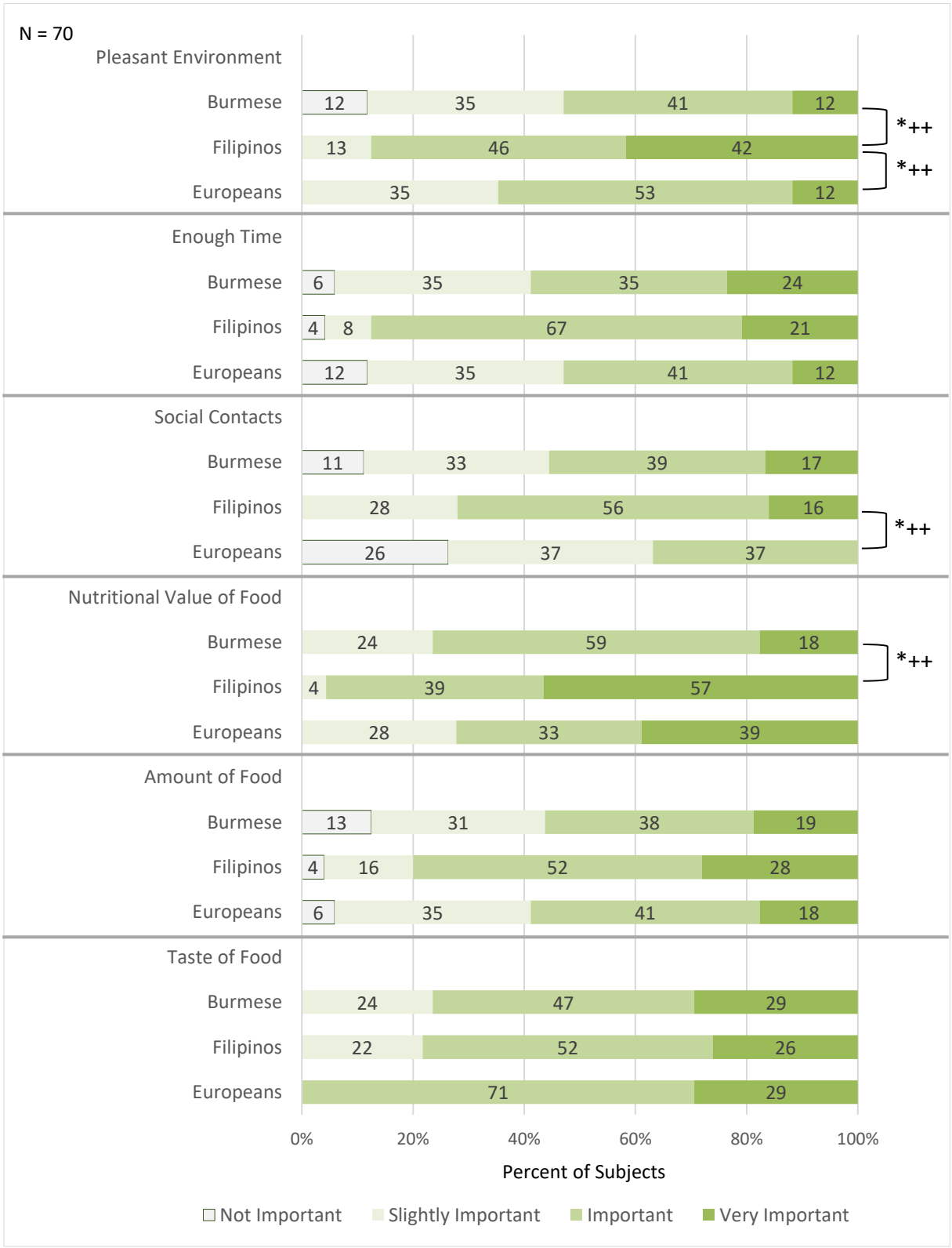

Figure 26. Importance of Various Aspects of the Eating Conditions as a Percentage of Groups

Question: Please rate the following aspects regarding their importance while eating. Group differences were tested with Kruskal-Wallis Tests with Post-hoc Dunn-Bonferroni-Tests. Parentheses indicate significant group differences. *p < 0,05. Effect sizes: $^{+}r < 0,3$. $^{++}r < 0,5$. $^{+++}r \geq 0,5$.

Use of health promotion apps:

Eighty-five percent of the respondents stated never to have used a health-promoting app before to control their eating behavior. However, 91% of the seafarers would be willing to use an app for health tracking, and 92% would be willing to share their data with health professionals (see Figure 27).

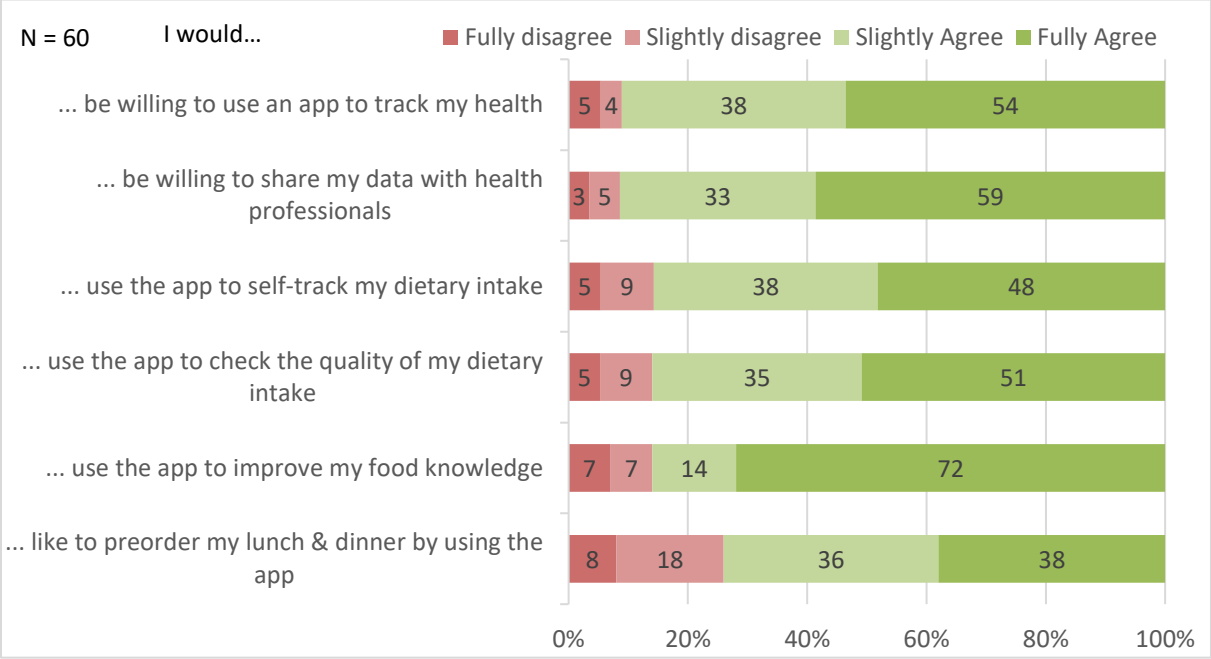

Figure 27. Questions about Health-promoting Apps as a Percentage of Groups

Presentation of results for the total study population as the Kruskal-Wallis test indicated no significant differences for nationalities.

When it comes to app functionalities, 86% of the seafarers replied that they would use the app to self-track their dietary intake and to check the quality of their dietary intake. The same percentage of participants declared they would use the information to improve their food knowledge. An app functionality, which would enable the seafarer to choose the meals for lunch and dinner from a few options on the day before received the lowest agreement. However, 74% of the seafarers answered that they would like to use an app for this purpose.

6 Discussion

The nutrition situation on board of merchant vessels is complicated, and to this day, few studies have explicitly investigated the nutritional status and dietary intake of seafarers or individual and environmental factors influencing the eating behavior. Additionally, only three health promotion interventions that were aimed at the improvement of food consumption on merchant vessels have been conducted to this day. However, the explorative cross-sectional approach of data collection for the "e-healthy ship" project aimed to improve current knowledge and could be useful for future intervention studies.

» Lifestyle-related health risks like BMI and increased blood parameters were prevalent in seafarers participating in "e-healthy ship «

The present study shows BMI results in line with previous findings. The European, Burmese and Philippine seafarers (M_E = 25,9; M_B = 26,2; M_P = 26,2 kg/m^2) of the "e-healthy ship" project had similar average BMI compared to the European seafarers (Med = 25,4 kg/m^2) of the SeaNut study, Danish seafarers (M = 26,1 kg/m^2), as well as Iranian seafarers (M = 25,3 kg/m^2) (Baygi et al., 2016; Jepsen & Rasmussen, 2016; Zyriax et al., 2018). However, it should be mentioned that some seafarer nationalities, which did not participate in this study, are affected to a larger extent. For example, a significantly higher BMI and waist circumference was found among Kiribati seafarers compared to European seafarers (Zyriax et al., 2018). Also, a study about US American inland waterway captains and pilots in merchant shipping showed a higher prevalence of obesity (61%) than a Danish study which found the prevalence of obesity among officers in the merchant marine to be lower (33%) (Hansen et al., 2011; Scovill et al., 2012).

Recent studies aimed at the observation of trends of cardiovascular risk factors and metabolic syndrome found an increase of BMI over time. Among 234 Iranian seafarers, Baygi, Jensen, Qorbani, et al. (2017) reported an increase in BMI of 1,15 kg/m^2 over four years. Jepsen & Rasmussen (2016), which observed metabolic syndrome trends among 141 seafarers reported an increase of BMI by 1,2 kg/m^2 after two years of follow-up. In the current study, the retrospective query about seafarers' weight development indicated an increase in weight and consequently also in BMI. However, the results for weight gain were lower compared to the studies mentioned above. European seafarers stated to have gained 2,4 kg/m^2 but throughout

their whole occupational career with 16,1 years of average work experience. The outcome for Filipinos and Burmese was slightly lower but the differences were not significant. Even though weight gain was lower in its absolute numbers compared to the other studies, the weight significantly increased over time regardless of their nationality. Moreover, blood samples showed concentrations of fasting blood glucose and lipids deviant from reference values. For Burmese the group means of blood glucose and triglycerides even surpassed the upper limit of recommendations.

All in all, BMI, weight development and blood sampling findings of the "e-healthy ship" population are in concord with other studies that investigated the risk factors for CVD and the metabolic syndrome (Jepsen & Rasmussen, 2016; von Katzler et al., 2019). However, these findings should be treated cautiously in terms of being representative of the entire seafarer population. That being said, at the very least, they can be viewed as an indicator for the impact of nutrition as a lifestyle factor on lifestyle-related diseases and can shape the scientific picture for further studies.

» Weight gain among seafarers might not always take place at sea «

The average energy balances measured in "e-healthy ship" resulted in being negative among the majority of the seafarers. The average TDEEs of the investigated Burmese (M_B = 3066,5 kcal), Philippine (M_F = 3111,0 kcal), and European (M_E = 3021,3 kcal) seafarers were higher compared to the average reported DMEIs (M_B = 2426,7; M_F = 2308,2; M_E = 2268,6 kcal). As results for the nutritional status indicated a weight gain over time and several studies reported frequent overeating among seafarers, the gathered data for energy expenditure and energy intake needs to be questioned for possible errors (Babicz-Zielińska & Zabrocki, 1998; Hjarnoe & Leppin, 2014a; Zyriax et al., 2018). Comparative values for energy expenditure reported by Zyriax et al. (2018) were between 2880 and 3563 kcal and thus in line with the results of this study. This was different regarding the results for energy intake. The European seafarers (Med = 3094 kcal) of the *SeaNut* study consumed considerably higher amounts of energy compared to the Burmese, Filipinos, and Europeans in "e-healthy ship."

In such cases, it is natural to initially suspect the possibility of underreporting of foods and drinks during the 24-hour dietary recall interviews which were responsible for low values of energy intake. (Johansson, Wikman, Ahrén, Hallmans, & Johansson, 2001) suggested an observed general underreporting ranging from 15 to 20% for 24-hour dietary recall data. This

tendency increases with higher BMI results and therefore has to be taken into account when evaluating the data of this study (Johansson et al., 2001). Furthermore, during the interviews, two Europeans out of eleven stated to be on a diet suggesting possible errors in the data set. Also, biases in the measurement of energy expenditure by the Polar watch, for example, due to the ship movements seem possible in retrospect. A recent systematic review reported the measurement of energy expenditure through activity trackers as being of low validity.

However, a negative energy balance was also present among Burmese and Philippine seafarers (TDEE approximately 20% higher than DMEI) and no data for comparison available. Of course, an underreporting as suggested before appears possible for these populations too. Nevertheless, reasons for these results other than overeating onboard need to be considered, such as weight change among Asian seafarers while at home. In general, the results of the nutritional status and energy balance do not provide causality between weight gain of seafarers and the eating situation onboard. They solely show that seafarers tend to gain weight over time while practicing their occupation.

Although several studies reported overeating onboard, most of these findings were based on self-disclosure (Hjarnoe & Leppin, 2014a). Due to high levels of physical activity, it is likely that the energy expenditure among seafarers is higher during their working-hours at sea compared to their free-time at home. Additionally, the ship environment offers large portion sizes of already prepared dishes which are free of charge and subsequently could lead to overeating (Hjarnoe & Leppin, 2014a). However, the question remains whether every seafarer gains weight onboard or if weight gain among seafarers is more diverse with weight gain partially taking place at home.

According to the “Pavlovian behavioral conditioning”, especially Asian seafarers with a period of nine months at sea are at risk to adapt to a high energy intake onboard and transfer this eating pattern into their eating behavior at home (van den Akker, Schyns, & Jansen, 2018). However, the cooks onboard all had an Asian background and thus could have partially failed to prepare tasty, culture-specific meals for Europeans, which consequently could have led to reduced quantities in food consumption.

Additionally, seafarers, due to their long working periods on board, dependent on their nationality do not have access to their favorite comestibles they prefer to have at home. For example, for Filipinos who rated the food at home to be significantly better than at sea, it would make even more sense for them to overeat on desired foods in their home

environment. This argument contrasts the findings of Westenhoefer et al. (2018) who reported overeating for Kiribati since they are exposed to a westernized food environment onboard that offers foods which have been desired for a long time due to lack of availability in their home country.

Also, cravings might be a factor for overeating among seafarers as these were found to be associated with boredom and emotional coping in a recent survey among Canadian adults (Vallis, 2019).

Considering the fact by itself, that physically demanding work should support to maintain a normal body weight, it is almost surprising that large proportions of seafarers are overweight or obese (DiPietro, 1999). To find out whether the majority of seafarer weight gain takes place onboard or at home, more detailed tracking of weight before and during the time spent at sea would be necessary. Both, at home and onboard a merchant ship, represent completely different living environments which affect seafarers in various ways and thus could favor or inhibit weight gain.

» Health promotion interventions on board of merchant vessels need to raise awareness for healthy eating «

The findings generated in this study via food interviews on board of merchant vessels confirm deficits in the diet of the seafarers, which were also partially mentioned by Babicz-Zielińska and Zabrocki (1998) and Zyriax et al. (2018) before. Among Europeans and Filipinos, the amounts of macronutrients for the DMEI were in comparison to the DACH recommendations, insufficient in carbohydrates. Fat intake was higher than the recommendations for Europeans. Furthermore, saturated FA, cholesterol, and protein intakes were higher, but the recommended fiber intake was not being met by any seafarer nationality. The distribution of macronutrients on the DMEI was most favorable among Burmese seafarers; however, if the nationality specific recommendations for Southeast Asian countries by the ILSI are consulted, Burmese also do not meet the DRV of the ILSI in this study.

The high intake of unfavorable fat sources onboard serves as part of the explanation for the findings in this study. Concerning the heightened critical intake of cholesterol as well as saturated FA, the increased lipid values found in the blood samples serve as a consequence as these turn out to be risk factors for CVD (Forouhi, Krauss, Taubes, & Willett, 2018).

In terms of nationalities, the results for macronutrients showed a gradient decline. Burmese consumed significantly more carbohydrates than Europeans and Filipinos while Europeans' fat intake was significantly higher than that of Burmese and Filipinos. Also, the fraction of the saturated FA in the diet of the European population was significantly higher, while EPA was significantly lower compared to the Burmese population. Additionally, the consumed amount of cholesterol in food was the lowest among the Burmese, yet not significant since the investigated diet for the Burmese seafarers showed the most favorable ratio between saturated FA and polyunsaturated FA among the groups. However, the logical conclusion that Burmese people working on merchant vessels would be less exposed to higher lipid values in their blood than the norm and would, therefore, be associated with a lower risk for CVD than Europeans was not supported by the results as the lipid values of the blood samples. These results indicated no significant differences among Burmese and Europeans. On the contrary, the results of the nutrition interview suggest that the macronutrient intake of the Burmese population on board appeared to be healthier. However, their intake turned out not to be more favorable as compared to the Europeans' diet due to the results of the blood samples.

About micronutrients, folate, vitamin C, vitamin D, vitamin E, potassium, calcium, and iodine were found to be below DACH recommendations for all nationalities. Vitamin A, specifically, was low among the Burmese and Filipinos, while the upper limit of the DACH recommendation for sodium (corresponding to salt) surpassed recommended levels among all groups. These findings are following the tendencies that were presented in the study of Zyriax et al. (2018). Low potassium intake has not been yet reported. For the recommendations of vitamin D to be considered, researchers must recognize that this micronutrient is synthesized by the human organism under sun exposure (Nair & Maseeh, 2012).

As a recommended action for a nutrition intervention on board of merchant vessels, the consumption of carbohydrates should be increased, and that of fat and protein decreased. Because fiber intake is too low, products that are high in carbohydrate and fiber, like buckwheat or whole-grain products, should be increased for European seafarers. For example, the daily breakfast offered during the "e-healthy ship" study (Sunday exception) contained sausages with egg, which were complemented with peeled rice for only the Burmese and Filipinos. The exchange with sandwiches made of whole-grain bread or breakfast cereals, like oatmeal, could change the distribution of macronutrients in a pleasant way. It should be

considered that dishes like oatmeal are very culture-specific and breakfasts have to be adapted to cultural origins like Asia.

Furthermore, foods like legumes and nuts could be introduced more frequently into seafarers' meals in order to increase fiber in their diet, even though legumes have quite a high amount in protein and nuts in fat respectively. Legumes also contain cholesterol, the intake which needs to be decreased since it is already oversaturated. However, an additional benefit of these foods due to high levels of polyunsaturated FA, fiber, and potassium, as well as folate, is not to be dismissed. In this instance, the advantages overpower the disadvantages. Regarding cholesterol intake, meat consumption should be reduced overall onboard either.

An increase in fish intake, especially deep-sea fish instead of meat, would be beneficial in the sense that the intake of vitamin D, vitamin E, iodine and polyunsaturated FA could be increased while simultaneously saturated FA and cholesterol could be decreased. This change would improve the balance of fats in blood samples (Forouhi et al., 2018). Adhering to similar reasoning, the utilization of plant oils like olive oil or rape oil is also encouraged. Besides, Zyriax et al. (2018) recommend introducing drinking water rich in calcium as the default water choice on board as well as exchanging table salt (sodium) with iodic salt in order to reduce nutrient deficiencies. Low intakes of vitamin C, folate, and potassium could be improved by increasing the intake of fruits and vegetables.

Approximately one-third of the queried seafarers took supplements. Unfortunately, the most frequent supplement taken covers the nutrients which are consumed less by the seafarers only in part. Calcium and Iodine are only partially supplemented, while potassium is not covered at all. If seafarers feel the need to add nutrients in other ways, they should receive information which nutrients should be favored by supplementing.

» A large variety of environmental and individual factors influence the eating behavior of seafarers on board of merchant vessels «

Previous studies reported that the fruit and vegetable intake onboard is decreased. The source for this data was extracted very differently among these studies. While Babicz-Zielińska and Zabrocki (1998) consulted the overall food delivery on 55 sea-going vessels and 36 deep-sea fishing ships categorizing and comparing fruit and vegetable intake with recommended consumption frequencies, Zyriax et al. (2018) based their data on the dishes prepared and served by the cooks of four container vessels.

Contradicting these studies, Burmese (89%), Philippine (84%) and European (90%) seafarers answered similarly with the statement that fruits and vegetables were available on the ships. This discrepancy in recommended intake and availability could be explained by Westenhoefer et al. (2018), who argued that structural factors guarantee that foods are sufficiently available, physical and economic access is given by default, and food provision is free to the seafarers.

However, the actual supply of fruits and vegetables on board is impacted by many factors like restricted storage space or a limited food repertoire (Hjarnoe & Leppin, 2014b). What food is stored onboard is determined by the delivery capacity of the caterers, the port where food is loaded, and the budget provided by the shipping companies (Hjarnoe & Leppin, 2014b). Which food is selected and then processed is incumbent upon the cook, but the actual decision to eat is an individual choice. Access to warm meals is guaranteed three times a day, prepared and provided by the cook. Therefore, the relevant scientific question regarding health on a ship should address the issue of low fruit and vegetable intake as opposed to the general availability of fruits and vegetables on board. Random observations during this study confirmed that the shortage of fresh foods with short shelf-life is well-known to the cooks. In order to have a constant supply, for example of fruits, the fruit with the shortest shelf life is consumed early on, and fruits that are more durable like apple and watermelon are frozen, allotted and therefore spared for later during the journey.

Regarding prepared dishes, seafarers' content varied. The majority of the crew indicated they were slightly satisfied or satisfied with the delicious look (80%), taste (77%), variety (77%), and quality (75%) of the food served onboard. However, ¼ of seafarers reported being unsatisfied or slightly unsatisfied with every aspect. Regarding the traditional food served in their home environments compared with the food served at sea, the majority of seafarers for the most part liked it better at home, except for the delicious look of food which appeared to be the same if not slightly better at sea which makes sense as meals are served by a professional. Nevertheless, the Burmese (100%) and Philippine (88%) seafarers agreed or slightly agreed that the cook would take the different nationalities into account when preparing food, contrasted with only 20% of European seafarers who disagreed or slightly disagreed with this statement.

Foods provided by the cook employed by shipping companies do not cover the wants for a diverse population and the needs of a balanced diet sufficiently. This is supported in the finding that two-thirds of the seafarers bought food (e.g., sweets, crisps, salted nuts) or drinks

(e.g., sugar-sweetened beverages, alcoholic beverages) at the ship store. Moreover, sixty-three percent of–Filipinos and fifteen percent of European seafarers stated that they sometimes ate fish that a fellow seafarer caught by fishing in his free time when the ship was anchored at port. Other sources of foods and drinks named by the seafarers were foods they brought from home at the beginning of a contract or purchased from shore leaves. All in all, it can be concluded that the choice for comestibles on board is limited.

Food choice is connected with further aspects and plays an important role in job satisfaction and well-being of the seafarers in their daily routine (Oldenburg, Baur, et al., 2010a; Witkowski, 2011).

The described “wants and needs” of the seafarers might result from an alternate diet at sea. Seafarers of all three nations consumed more vegetables, fruits, fish at home but less sausage, noodles, chips, and salted nuts, cola, coffee, sweetened tea, and spirits compared with their time at sea. This finding suggests that independent from cultural differences in the diet at home, the impact of the work environment onboard of merchant vessels is so crucial that for all seafarers, regardless of nationality, the adapted diet onboard shows the same tendencies. An applicable example is the consumption of sausage. Even though the European group consumed more sausage at home than the Burmese and Filipinos, the overall sausage intake among all the three nationalities is heightened in comparison to home intake. This shift in dietary patterns from "home" to "at sea" beholds disadvantageous changes within its nature. As discussed before, high consumption of vegetables, fruits and fish is beneficial, as is a decreased intake of foods high in saturated fatty acids and sodium, as well as drinks high in sugar, like cola or sweetened tea.

Regarding additional food categories like potato and milk for Europeans in comparison to Asian seafarers or egg for Burmese, findings show cultural dietary aspects can be impacted by the food onboard differently. These findings show that dishes prepared by cooks on board are not sufficiently adapted to cultural specifics, even though adjustment efforts have been made as seen with the agreement between most seafarers that cooks “take the seafarers nationalities into account while cooking.” In this regard, the cook must be trained on how to cook for various nationalities and therefore, cultures.

As for the mere availability of fruits and vegetables on board which was mutually affirmed by the seafarers, it does not necessarily equate to a sufficient amount of fruit and vegetables on board. Nevertheless, in response to a nutritional knowledge question, the majority of

seafarers agreed correctly that fruits and vegetables and fish are part of a healthy diet, but only 51% replied that fruits and vegetables should be consumed several times daily. Despite the presence of some nutrition knowledge, it cannot be extrapolated that this knowledge always leads to the implementation of a healthier diet. Nevertheless, these results showed that individual behavior might also contribute to the low consumption of fruits, vegetables, and fish onboard. Whether it is due to a physical non-existence on board because of delivery shortages (Babicz-Zielińska & Zabrocki, 1998), the cook is not serving sufficiently enough fruit and vegetables (Zyriax et al., 2018), or the individual choices of the consumer themselves to eat less fruit and vegetables, it is impossible to differentiate this reasoning in the analysis made throughout this study. However, the personal initiative to get access to limited foods like fish by fishing indicates a strong desire for this food.

In addition to the argument above, if food knowledge leads to improved eating behavior, seafarers should rate the consumption of coffee, sweetened tea, and cola as not healthy. However, they consume it less at home and consequently more often when at sea. A plausible scenario could be that these types of drinks are consumed because they are caffeinated, helping with alertness during night shifts. Regarding the examination of knowledge if meat and lemonade are part of healthy diet seafarers were discordant.

The present study's population indicated a high interest in information about healthy food (92%). However, only 30% of Burmese, 40% of Europeans and 68% of Filipinos rated their nutritional knowledge as good. Even though the difference in results between Burmese and Filipinos was significant, a varied state of knowledge could only be determined for a few questions. Given the responses of the self-evaluation regarding nutritional knowledge, Europeans answered correctly most frequently. However, answers to questions about nutritional knowledge were not known by up to 50% of the seafarers. This insight, combined with self-reported willingness to learn about a healthy diet suggests that healthy diet interventions aiming at sharing knowledge about a healthy diet, have good chances of succeeding.

» Seafarers are open-minded regarding nutrition-related health promotion interventions «

Any intervention idea presented within the questionnaires that meant a change onboard proved popular among the seafarers. Whether the implementation of all these measurements onboard would be useful and practical, appears to be a secondary concern. The desire to

change the food situation is so strong that every change is considered a good change, whether it would be food labeling by nutritional value, changes addressing the traditional barbecue or an e-health intervention. A health-promoting app could be used as an e-learning platform as well as for health tracking since 92% replied they were willing to share their data with health professionals.

» A successful maritime-adapted intervention promoting a healthy diet needs to address all layers of the nutrition situation in the maritime industry «

By instrumentalizing cooks as a gatekeeper for nutrition; Hjarnoe and Leppin (2014b) report that promotion of a healthy diet at sea is possible but needs to overcome the occupational challenges of the maritime industry. It is a challenging goal because such changes are both large and small-scale and need to address not only the cook but also all other levels related to nutrition within the maritime shipping sector.

First and foremost, the regulations adopted by the Maritime Labour Convention (International Labour Organization, 2017) are not sufficient to guarantee a nutritious and healthy diet on board of merchant vessels. Stricter regulations and guidelines are needed to increase the accountability of shipping companies' management to establish access to healthy food at sea. Hjarnoe and Leppin (2014b) see it as necessary responsibility of the management to take care of the change implementation since seafarers do not have other food options when on board.

Another approach that offers chances for improvement is to make modifications to the food ordering processes and the delivery of foods to the vessels. Ship cooks, for the most part, are not educated to take responsibility for the order but are expected to consider seafarers' nutritional needs as well as logistical difficulties in advance (Oldenburg, Baur, et al., 2010a). However, the food order form completed by the cook usually receives changes by the shipmasters, which try to align the wishes of the cook with the often-low budgets supplied by the shipping companies. A shipmaster of one studied ship reported that cooks frequently hand in the same or similar food order form as the previous cook. He concluded that this task might be experienced as too complicated in addition to the daily working tasks. Regardless if this anecdote by one shipmaster is correct, Babicz-Zielińska and Zabrocki (1998) found that proportions of ordered foods result in unfavorable diets onboard. Therefore, support is necessary and should be provided to the ship's cooks to improve food proportions. Hjarnoe and Leppin (2014b) suggested that substitutions for sugary foods and fat (e.g. offering cut

vegetables instead of cake) as well as abolishment of soda drinks had to be made on the level of the supply chain. Furthermore, food variety should be improved, which could be achieved by pre-fabricated filled in order forms. Also, modified food ordering forms which set minimum and maximum quantities for foods from certain food groups should be considered an option.

Additionally, catering deliveries are not controlled and thus supply foods of varying quality. The introduction and establishment of a seal of quality for catering services could help to improve the food situation onboard. However, a short-term realization may not be welcome among caterers, and thus feasibility remains questionable due to limited support from the industry.

Further, necessary factors for the shipping companies to take care of include sufficient space and storage facilities and an appropriate budget for healthy food options (Hjarnoe & Leppin, 2014b). The ship store that usually supplies the seafarers with sweets, snacks, sugar-sweetened beverages and consumable items needed for everyday life could also offer healthy foods independent from the kitchen, such as dried fruits and vegetables, dried fish and unsalted nuts. Making healthy options available for purchase may also reduce consumption of unhealthy sweets and snacks.

Practical intervention methods for cooks to practice were explored in an intervention study with ship cooks by Hjarnoe and Leppin (2014b), which report that “invisible changes” like reducing fat and sugar of familiar dishes would be the easiest to apply. A stepwise adjustment to the recommended proportions of the healthy eating plate over several weeks is another approach that should be tested (Harvard School of Public Health, 2019). New dishes from a cookbook made available for the study were rarely provided in regular intervals (Hjarnoe & Leppin, 2014b). Nevertheless, using cookbooks and recipe collections to expand the range of culture-specific and prepared dishes and training courses for cooks is essential. Westenhoefer et al., (2018) suggest that in order to increase satisfaction regarding the eating situation and therefore self-determination of seafarers, more options that cater to European needs should be introduced.

Furthermore, Westenhoefer et al. (2018) mention the principles of nudging as a promising strategy to influence seafarers’ food choice and consumption. Nudging could be applied, for example, during coffee breaks by offering pre-cut fruits on the tables of the messroom, in place of cookies which are commonly offered (Thaler & Sunstein, 2009).

Hjarnoe and Leppin (2014b) reported that the attempt to change dietary habits onboard the ships faces resistance, especially by older seafarers who intend to maintain traditions regarding their food intake. Therefore, ship cooks are exposed to social pressure by colleagues, and even more by higher-ranked officers such as the shipmaster who has the power to diminish the success of an intervention single-handedly. Additionally, recognition for good cooking may be relevant for many cooks as the situation of handing out dishes is one of the most frequent social interactions for cooks during the working day. In order to successfully introduce dishes to the ship, it would be the task of an intervention to recommend recipes that are tasty and healthy. Unfortunately, due to the multinational crews with different preferences, it appears challenging to satisfy everybody on board, but an intervention that takes cultural preferences into consideration may satisfy the majority of crew members (Oldenburg, Baur, et al., 2010a; Zyriax et al., 2018).

» The success of the implementation of an e-learning app remains to be seen «

Contrary to the positive feedback regarding the implementation of a health-promoting e-learning app, Hjarnoe and Leppin (2013) attribute the little effort of seafarers to occupy themselves with nutritional information onboard to a low motivation to participate. Also, Westenhoefer et al. (2018) question if it would be useful to simply provide seafarers with health information. If Burmese and Filipinos show higher motivation compared to the Danish seafarers of the study by Hjarnoe and Leppin (2013) needs to be investigated further. However, the health content should be illustrated appropriately and adapted to the maritime environment to raise interest. Additionally, gamification should be considered as an option on how to educate nutritional knowledge as it presents a promising strategy (Holzmann et al., 2019).

» Limitations «

The versatility of seafarers concerning origin, religion, culture, socioeconomic status, the different types of jobs and working conditions, as well as the prevailing living conditions onboard merchant vessels reflect a variety of difficulties for scientific investigations of seafarer nutrition and health. These challenges also apply to the current study.

Firstly, the 70 investigated seafarers onboard the three visited vessels were from 13 countries, which were analyzed as groups of Burmese, Philippine, and European seafarers. Cultural

differences among various European nationalities may bias the results for the European group.

Secondly, baseline and occupational data showed that for the investigated study population, European seafarers were associated with the rank “officer” and Filipinos with “crew ranks.” Mixing of findings regarding cultural differences and socioeconomic status cannot be ignored along with genetic factors.

Thirdly, the results of “e-healthy ship” were based on the data collection on two container vessels as well as one bulk carrier and therefore only represent two different ship types. Nevertheless, with a participation rate above 90%, the study population is highly representative of seafarers working on container vessels and bulk carriers.

Fourthly, findings, and conclusions have inherent uncertainty and are obviously limited to male seafarers.

Fifthly, it needs to be mentioned that the small study population divided into three groups only allowed finding significant differences in group comparisons that were at least of medium effect size. Small effect sizes remained statistically irrelevant. For that reason, also a more detailed analysis, for example, among crew ranks, was not possible regarding the small dataset.

Lastly, this study is based on a cross-sectional approach which excludes the possibility of cause-effect interpretations.

7 Conclusion

In conclusion, this study on board of three merchant ships generated new hypotheses and was the first to investigate possible connections between the nutritional status and dietary intake, as well as working and living conditions among Burmese, Filipino and European seafarers. Therefore, the results of the "e-healthy ship" project close a gap in research, even though findings and conclusions in this study are explorative and provide knowledge on how to successfully implement and maintain nutrition interventions in the maritime setting.

This study for the first time indicated that risk factors for cancer and cardiovascular disease, such as overweight, increased blood glucose, and deviating blood lipid profiles, were found to be prevalent among Southeast Asian seafarers from Burma and the Philippines. As Southeast Asian countries provide the most considerable part of the seafarer body regarding the international shipping industry, these findings are of crucial importance to describe the working environment and to generalize findings for the employees. Tied in with the fact that scientific work aims to gain perspective regarding a holistic picture of the actual work conditions as well as the complete framework that embeds employees in the maritime shipping industry, future studies should focus on generating larger sample sizes while simultaneously differentiating these populations more into their cultural categories. As nationalities were the obvious choice for groups, categorizing shall be executed more meticulously taken into account that the group of Europeans in this study is a potpourri of different nationalities each having their own food culture, and therefore, have to be considered when exploring cultural specifics. Especially the gap between Eastern and Western European nationalities has to be investigated as by mere observations different food culture is strongly suggested to be existent.

Multiple factors need to be identified in order to measure valid and reliable effects. Future studies should focus on factors which individualize the working conditions aboard merchant vessels, such as the employing shipping company, ship type, working shifts, working area, and the rank of a crew member. Those factors have to be investigated in combination with nationality categorization in order to gain representativeness of conclusions for the maritime work environment and the subpopulations of seafarers.

The status quo, as well as the development of health for seafarers, can only be taken into account if the area of conflict, as in long periods of being home vs. at sea, is highlighted. This

fact occurred for findings regarding the food patterns at home and sea in this study. It is strongly suggested that these results have to be replicated using a proper longitudinal study design to ensure causal conclusions regarding developmental measurements like weight, or the adaptation of the seafarer to proportion sizes and the intake of macro- and micronutrients at sea.

Of special interest appear to be the conditions under which poor dietary patterns worm their way into the work setting of seafarers. Structural factors can be explanatory, for example, long working hours, the mere availability of food are crucial for decreased health among employees at sea, or even completely different factors could be a relevant linkage in order to understand health lifestyle onboard like loneliness or social isolation. Mental health was completely neglected in this study and should be investigated in further studies either. Especially with substance abuse (e.g. alcohol) as a commonly known coping mechanism among seafarers health could be severely affected (Pougnet et al., 2014).

In a nutshell, it can be illustrated that there is still a long way to go in order to fully understand the maritime work environment regarding health impact onto the employees at sea. Scientific findings are still considered to be in the fledgling stages and therefore have to be solidified in the next decades. Even though the results of this study can only be interpreted as explorative and concrete hypotheses have to be deducted and investigated in further studies, they can serve as a base to understand the underlying processes of the maritime work environment in order to change impacting factors on the healthy lifestyle at sea successfully.

Particularly intersections for interventions and their implementation in order to install a healthier lifestyle among seafarers appear to be various: Interventions can be applied for delivery chains of the shipping company, food supplies, training of the cook in order to prepare cultural specific dishes as to name a few and have to be examined regarding their practicability in the maritime setting. Since interventions have an economic weight to them which cannot always be met by each shipping company regarding their budget these factors have to be investigated further in order to adapt lifestyle interventions to the maritime needs successfully.

As a consequence of this study, recommendations for action are suggested in the following chapter. It is the responsibility of shipping companies and researchers to implement interventions promoting healthy nutrition on board of merchant vessels and thereby to contain the growing prevalence of lifestyle-related diseases.

8 Recommendations for Action

All contributors to the nutritional situation on board of merchant ships need to be addressed to improve the dietary intake of seafarers: the food supply of the ship, the food preparation by the cook, and the food choice by the individual. The following actions are recommended:

1. Food supply on the ship: healthy food options must be available onboard. Food orders should be guided.
    a. Develop guidelines for catering companies.
    b. Develop guidelines for ordering food from caterers.
    c. Implement a healthy food stock in the ship store by making dried fruits and vegetables, dried fish, and unsalted nuts available.
    d. Replace traditionally ordered foods with foods that improve seafarer- and culture-specific nutrient supply. E.g., reduce the order of meats, sausages, as well as other foods high in saturated FA, and increase the order of fruits, vegetables, legumes, full-grain products, and fish.
    e. Introduce supply changes, e.g., water rich in calcium, as well as iodic salt instead of table salt, and establish these as standard onboard
2. Food preparation: The cook needs to be adequately educated. He is responsible for the majority of foods being consumed by seafarers.
    a. Recipe collections with meals that are country-specific for seafarers need to be available onboard every vessel.
    b. Support the cook with the implementation of proportions of the healthy eating plate, healthy food preparation, and “invisible changes,” such as a reduction of salt use.
    c. Teach cooks how to influence seafarers’ food choices and consumption and raise awareness about quickly implemented nudging methods, e.g., offering cut fruits and vegetables instead of cookies during the coffee breaks.
3. Food choice by the individuals: Every seafarer decides their meals and drinks. Properly educate seafarers on nutrition so that they can make the right decisions.
    a. Educate seafarers on healthy food options, portion sizes, and the importance of a healthy diet.

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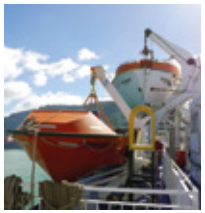
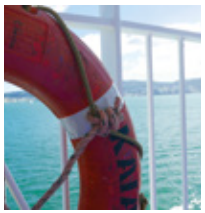



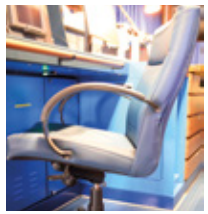
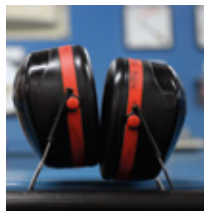
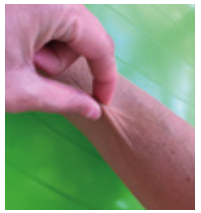
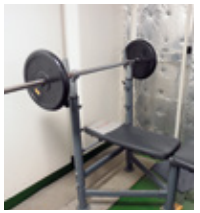
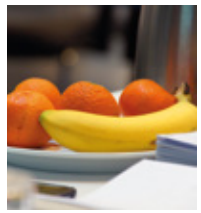

What is happening and why?

We are a **team of scientists** and will join your vessel to accompany daily work for about 14 days (and one year later for 7 days).

We are doing this because you live and work in a challenging environment.

We want to learn about your **health condition** as well as your **nutritional and sports routines** on board ship.

After data collection, we will develop preventive measures that may assist to improve your working and living conditions on board.

What are we doing exactly?

We come aboard your ship and will interview you in the context of our EU-funded project, called *e-healthy ship*. We concentrate on different health aspects:

- physical fitness (your heart rate, blood pressure, activity, body movement)
- nutrition
- ergonomics
- skin
- fatigue (duration and quality of your sleep)
- mental health conditions

We consider your opinion and ideas about the working and living situation and the stress you experience every day.

Why should you participate?

It is all about YOUR health.

You will receive a lot of seafaring specific information on nutrition, sport and relaxation technique.

We will also publish our findings and conclusions. They will hopefully inspire other scientists and help to improve the prevention of health issues for all those who work and live at sea.

Your observations and ideas will also help us to improve the training of health officers in our refresher classes and to find out where they need more support onboard. All this is to constantly make every aspect of shipboard health management a little better.

MARCUS:
ALL THE NFORMAT ON WE GET FROM YOU W LL BE ANONYM ZED AND TREATED CONF DENT ALLY.

NICOLA:
WHEN WE GET ON BOARD, WE W LL NFORM YOU N DETA L AND ANSWER ALL YOUR QUEST ONS.

FELIX:
T W LL PROBABLY BE NTERES-T NG, MAYBE EVEN FUN, TO TALK AND LEARN FROM EACH OTHER.

SUSANNE:
WE ARE LOOK NG FORWARD TO WORK NG W TH YOU.

DOROTHEE:
JUST BE PART OF T!

e-healthy ship

What does your employer say?

Peter Döhle Schiffahrts-KG

Roy Machart

We are one of the partners of the project *e-healthy ship*, which is all about health, nutrition and fitness on board.

With this project you have the opportunity to be a pioneer in our studies, whose results can influence the work and lives of thousands of sailors.

You can help us to promote health aspects and optimize health processes on board which can be a benefit for your daily work as well.

Taking part in this research is entirely voluntary and of course all your data will be treated high confidentially.

Who are we?

We are an interdisciplinary team of the EU project *e-healthy ship* which consists of four project partners. Our scientists, focussed on the investigation of the health status of seafarers, are from the institution ZfAM. It is part of the University of Hamburg in Germany and engaged in research of martime health matters.

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BE PART OF OUR HEALTH MANAGEMENT PROJECT!

More about the project:

www.e-healthy-ship.eu

e-hea thy ship is an interdiscip inary project to improve hea th management on vesse s. It is funded by the European Union (European Regiona Deve opment Fund) and the Free Hanseatic City of Hamburg (Ministry of Hea th and Consumer Protection).

ZfAM · UKE · hanseaticsoft · Peter Döhle Schiffahrts-KG · REEDEREI ROTH

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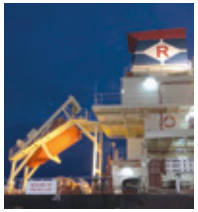

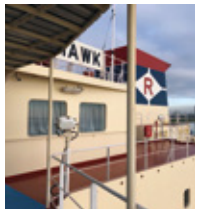

e-healthy ship

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REEDEREI ROTH

Thorsten Meier

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ZfAM UKE hanseaticsoft Peter Döhle Schiffahrts-KG REEDEREI ROTH

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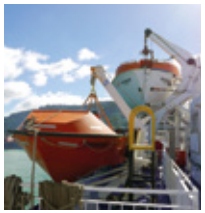
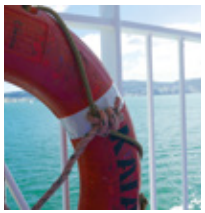
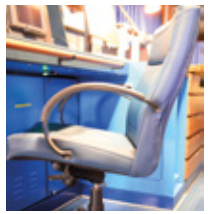
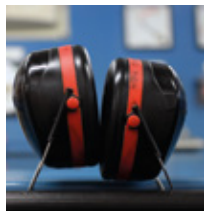
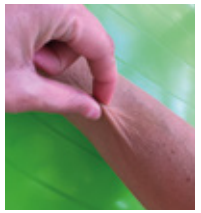
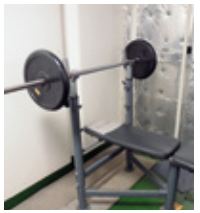
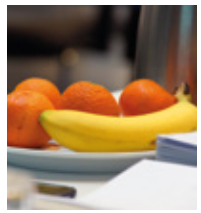





What is happening and why?

We are a **team of scientists** and will join your vessel to accompany daily work for about 14 days (and one year later for 7 days).

We are doing this because you live and work in a challenging environment.

We want to learn about your **health condition** as well as your **nutritional and sports routines** on board ship.

After data collection, we will develop preventive measures that may assist to improve your working and living conditions on board.

What are we doing exactly?

We come aboard your ship and will interview you in the context of our EU-funded project, called *e-healthy ship*. We concentrate on different health aspects:

- physical fitness (your heart rate, blood pressure, activity, body movement)
- nutrition
- ergonomics
- skin
- fatigue (duration and quality of your sleep)
- mental health conditions

We consider your opinion and ideas about the working and living situation and the stress you experience every day.

Why should you participate?

It is all about YOUR health.

You will receive a lot of seafaring specific information on nutrition, sport and relaxation technique.

We will also publish our findings and conclusions. They will hopefully inspire other scientists and help to improve the prevention of health issues for all those who work and live at sea.

Your observations and ideas will also help us to improve the training of health officers in our refresher classes and to find out where they need more support onboard. All this is to constantly make every aspect of shipboard health management a little better.

MARCUS:
ALL THE NFORMAT ON WE GET FROM YOU W LL BE ANONYM ZED AND TREATED CONF DENT ALLY.

NICOLA:
WHEN WE GET ON BOARD, WE W LL NFORM YOU N DETA L AND ANSWER ALL YOUR QUEST ONS.

FELIX:
T W LL PROBABLY BE NTERES- T NG, MAYBE EVEN FUN, TO TALK AND LEARN FROM EACH OTHER.

SUSANNE:
WE ARE LOOK NG FORWARD TO WORK NG W TH YOU.

DOROTHEE:
JUST BE PART OF T!

2.1.2 Why it is important reduce your body weight

Weight loss can improve your health condition in many ways.
It is recommended to lower elevated blood pressure, Cholesterol and Blood-Sugar levels. The combination of a reduced-calorie diet and increased physical activity is recommended, because it produces weight loss that also may result in decreases in fat around your waist and increases in fitness of heart and lung. But it is very important not only to reduce the calorie-intake, it is also very important to get the right amount of proteins, vitamins and micronutrians. Suggestions for a healthy diet you will find in the chapter “Our suggestions to you” under 2.5.
Initially, moderate levels of physical activity for 30 to 45 minutes, 3 to 5 days a week, should be encouraged.

This website offers some key recommendations about weight loss:
https://www.nhlbi.nih.gov/health/educational/lose_wt/recommen.htm

2.2.2 Low-Fat Diet

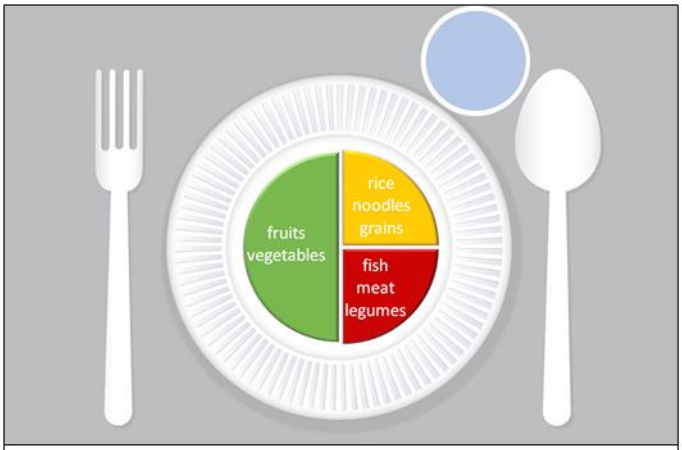
Our results indicate that the average of seafarers’ fat consumption is above the recommendation of about 30% of total energy intake. As this might increase the risk of overweight and cardiovascular disease, it is important for seafarers’ health to take care of the amount and origin of fats consumed.
Unsaturated fats, that are found in fish, avocado, nuts, sunflower, soybean, canola and olive oils are preferable to…
… **saturated fats**, that are found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard
… and **ruminant *trans*-fats** that are found in meat and dairy foods from ruminant animals, such as cows, sheep, goats and camels.
Industrially-produced *trans*-fats that are found in baked and fried foods, and pre-packaged snacks and foods, such as frozen pizza, pies, cookies, biscuits, wafers, and cooking oils and spreads are not part of a healthy diet and should be avoided.

http://www.who.int/en/news-room/fact-sheets/detail/healthy-diet

2.5 Healthy Nutrition

Eating healthy throughout the life-course helps to prevent from malnutrition, diseases and other conditions. Therefore, nutritions' importance for the health status is clear, but the the question "What do I need to eat to stay healthy?" remains. The following list includes some short recommendations for a healthy diet:

- Eating at least 400 g, or five portions, of fruits and vegetables per day helps to ensure an adequate daily intake of dietary fiber.
- Eat fish for at least 1-2 times a week
- Reduce your meat consumption (don't eat meat every day)
- Drink two liters of water a day. If you are hard-working or practice a lot of sports a higher supply might be necessary.
- Make your plate look like this:



This picture shows the recommendation of a healthy eating plate for lunch/dinner. If in times you are hard-working and therefore in need of a lot of energy additional parts of rice/ noodles/ grains might be necessary.

For more detailed information we recommend the following website:

https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/nutrition-basics

Survey: e-healthy ship - Declaration of Consent

e-healthy ship - Decleration of consent

Dear Sir or Madam,

welcome to our study called *e-healthy ship*!

In the last years the health management in companies has moved into the focus worldwide.
With the help of this survey we would like to examine, which occupational exposures exist in your job and related health stresses. Parts of the survey are based on standardized questionnaires, which are necessary, to reach an international comparability. Even if these standardized questionnaires did not correspond in all areas with the seaman's profession, we kindly ask you, to answer these questions too.
The results will make an important contribution for the health prevention of seafarers. The objectives and the complete study design are described in the attachment handed over by your interviewer. Also the study concept as well as the survey and examination methods are explained there.
Your participation is absolutely voluntary. If you are not participating, there are no disadvantages for you. Prior the start of the questionnaire, we kindly ask you for your written consent for participation in the survey, as described in the data protection concept (see attachment).
We assure you that all information given is kept strictly confidential. Data collection and processing are carried out anonymously. This will ensure that nobody can draw conclusions on your person.
If you have missed one question, you will be notified. To increase the significance, we kindly ask you, to take part in the study and to answer all questions. Please specify what applies for you personally. There are no right or wrong answers.

Thank you for your support!

If there are any questions please contact the project leader Dr. Marcus Oldenburg: e-healthy-ship@bgv.hamburg.de.

☐ **I voluntarily agree to participate in the e-healthy ship study**

---

* **Name of Study Participant**

ID of Participant

Appendix D. Food Diary Spreadsheet in Preparation for Interviews

Please note everything you **eat and drink** on the day before your "recall-meeting" with the nutritionist. Try to be as precise as possible and name every single ingredient of a meal. Please also write down the **amounts** of the foods and drinks you consume. If you struggle with guessing the amounts you can also document your food intake by taking pictures with your phone. Thank you for your cooperation!

Meal	Amounts
Breakfast	
Snack between meals	
Lunch	
Snack between meals	
Dinner	
Snack after dinner	

Appendix E. Scheme of Questions for 24-hour recalls

24-hour-Recall:

Meals:

- *Breakfast*
- *meal between breakfast and lunch*
- *lunch*
- *meal between lunch and dinner*
- *dinner*
- *meal between dinner and breakfast*

Scheme of questions

1. Did you have _____ (meal)? (if yes go on with 1a, if no go on with 2)
    a. What exactly did you eat?
    b. Did you use any additions (e.g. oils, sauces, spices, toppings, etc.)?
    c. Which amounts? (show pictures)
    d. Where there left-overs?
    e. Did you eat anything else? (if yes return to 1a, if no go on with 2)
2. Did you drink something? (if yes go on with 2a, if no go on with 3)
    a. What did you drink?
    b. Which amounts? (show pictures)
    c. Did you drink anything else? (if yes return to 2a, if no go on with 3)
3. Did you have dessert? (only lunch & dinner) (if yes go on with 3a, if no go on with 4)
    a. What did you eat?
    b. Which amounts? (show pictures)
    c. Where there left-overs?
4. Summarize the whole meal and ask if it was complete. Start over at 1 with the next meal until you asked about all meals listed above.
5. At the end of questioning: Was this a typical day regarding your food intake? Was it more food or less food?

Survey: e-healthy ship - Demographic and Occupational Data

e-healthy - Demographic and Occupational Data

* **Bitte die ID des Probanden eingeben:**

*

Demographic and occupational data

How long have you worked as a seafarer?

years

*

Demographic and occupational data

When have you signed on this ship?

DayMonthYear

-- -- --

*

Demographic and occupational data

When will you sign-off this ship?

DayMonthYear

-- -- --

* **Demographic and occupational data**

Do you feel this duration of total stay is…

○ too short? ○ appropriate? ○ too long?

* Demographic and occupational data

If you think it is too long or too short, what is the suitable duration?

_____ months

---

*

Demographic and occupational data

What is your rank?

- ○ Captain
- ○ Chief Engineer
- ○ Crew Engine
- ○ Cook
- ○ Nautical Officer
- ○ Technical Officer
- ○ Crew Deck (OS/ AB)
- ○ Steward

---

*

Demographic and occupational data

What is your age?

_____ years

Demographic and occupational data

What is your nationality?

---

* Demographic and occupational data

Are you...

- ○ Female
- ○ Male
- ○ Other _____

---

* Demographic and occupational data

What is your family status?

- ○ Single
- ○ Married / Partnership

* Demographic and occupational data

Do you have children?

- ○ Yes
- ○ No

* Demographic and occupational data

What is your smoking status?

- ○ I have never smoked (apart from rare trying)
- ○ Yes, I smoke
- ○ Yes, I smoked in the past, but I do not smoke at present

Please enter the number of years that you smoke:

Please enter the number of cigaretts that you approximately smoke per day

Please enter the number of years that you smoked in the past:

Please enter the number of cigaretts that you approximately smoked in the past per day:

* Demographic and occupational data

Do you drink alcohol?

○ Yes ○ No

How many portions of beer do you drink per week?
(1 portion = 0,5l beer)

How many portions of wine do you drink per week?
(1 portion = 0,25l wine)

How many portions of hard liquor do you drink per week?
(1 portion = 0,1l hard liquor)

e-healthy ship 23.01.2018; ZfAM, Version 1

Survey: e-healthy ship - Nutrition - Main Questionnaire

e-healthy ship - Nutrition - Main Questionnaire

* **Bitte die ID des Probanden eingeben:**

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*

When I am in my home country the majority of food is prepared by...
(more than one answers possible)

- ☐ Myself
- ☐ My wife
- ☐ another family member
- ☐ a restaurant
- ☐ Other

---

* **Compared to on board, the amount of meals I have a day when I am in my home country is…**

- ○ less
- ○ the same
- ○ more

How many <u>meals</u> do you have in your homecountry a day (in average)?

	0	7
* Meals per day in average		-

Compared to on board, how frequently do you eat the following foods, <u>when you are in your home country</u>:

	Considerately less	Somewhat less	Equal	Somewhat more	Considerately more	Don't know	Not part of my diet
* Bread	○	○	○	○	○	○	○
* Rice	○	○	○	○	○	○	○
* Noodles	○	○	○	○	○	○	○
* Potato	○	○	○	○	○	○	○
* Vegetables	○	○	○	○	○	○	○
* Salad	○	○	○	○	○	○	○
* Fruits	○	○	○	○	○	○	○
* Milk & milk products	○	○	○	○	○	○	○
* Cheese	○	○	○	○	○	○	○
* Meat	○	○	○	○	○	○	○
* Sausage	○	○	○	○	○	○	○
* Fish	○	○	○	○	○	○	○
* Egg	○	○	○	○	○	○	○
* Cake, sweets, cookies & confectionery	○	○	○	○	○	○	○
* Chips & Salted nuts	○	○	○	○	○	○	○

When you are in your home country, how often do you usually eat...

	Not part of my diet	Less than monthly	Monthly	Weekly	Daily	Several times a day	Don't know
* Bread	○	○	○	○	○	○	○
* Rice	○	○	○	○	○	○	○
* Noodles	○	○	○	○	○	○	○
* Potato	○	○	○	○	○	○	○
* Vegetables	○	○	○	○	○	○	○
* Salad	○	○	○	○	○	○	○
* Fruits	○	○	○	○	○	○	○
* Milk & milk products	○	○	○	○	○	○	○
* Cheese	○	○	○	○	○	○	○
* Meat	○	○	○	○	○	○	○
* Sausage	○	○	○	○	○	○	○
* Fish	○	○	○	○	○	○	○
* Egg	○	○	○	○	○	○	○
* Cake, sweets, cookies & confectionery	○	○	○	○	○	○	○
* Chips & Salted nuts	○	○	○	○	○	○	○

Compared to on board, how frequently do you drink the following beverages, when you are in your home country:

	Considerately less	Somewhat less	Equal	Somewhat more	Considerately more	Don't know	Not part of my diet
* Water	○	○	○	○	○	○	○
* Coffee	○	○	○	○	○	○	○
* Tea	○	○	○	○	○	○	○
* Cola	○	○	○	○	○	○	○
* Lemonade	○	○	○	○	○	○	○
* Ice tea	○	○	○	○	○	○	○
* Sweetened tea	○	○	○	○	○	○	○
* Cola zero & sugar reduced lemonade	○	○	○	○	○	○	○
* Fruit juice	○	○	○	○	○	○	○
* Beer/Wine	○	○	○	○	○	○	○
* Spirits	○	○	○	○	○	○	○

When you are in your home country, how much do you usually drink per day in average?
(glass = 250ml; shot = 2cl)

	1-2 glasses	3-4 glasses	5-6 glasses	7-8 glasses	9-10 glasses	>10 glasses	Don't know	Not part of my diet
* Water	○	○	○	○	○	○	○	○
* Coffee	○	○	○	○	○	○	○	○
* Tea	○	○	○	○	○	○	○	○
* Cola	○	○	○	○	○	○	○	○
* Lemonade	○	○	○	○	○	○	○	○
* Ice tea	○	○	○	○	○	○	○	○
* Sweetened tea	○	○	○	○	○	○	○	○
* Cola zero & sugar reduced lemonade	○	○	○	○	○	○	○	○
* Fruit juice	○	○	○	○	○	○	○	○
* Beer/wine	○	○	○	○	○	○	○	○
* Spirits (glasses=shots)	○	○	○	○	○	○	○	○

How many meals do you have onboard a day (in average)?

	0	>7
* Meals per day on board		-

* **Is the amount of food receiving on board sufficient for you?**

- ○ Yes
- ○ No
- ○ Sometimes

*

How satisfied are you with the taste of food on board?

- ○ Unsatisfied
- ○ Slightly unsatisfied
- ○ Slightly satisfied
- ○ Satisfied
- ○ I don't know

*

Concerning the taste of food in my home country I am satisfied.

- ○ Less
- ○ Evenly
- ○ More

* **How satisfied are you with the quality of food on board?**

- ○ Unsatisfied
- ○ Slightly unsatisfied
- ○ Slightly satisfied
- ○ Satisfied
- ○ I don't know

* **Concerning the quality of food in my home country I am satisfied.**

- ○ Less
- ○ Evenly
- ○ More

* **How satisfied are you with the variety of food on board?**

- ○ Unsatisfied
- ○ Slightly unsatisfied
- ○ Slightly satisfied
- ○ Satisfied
- ○ I don't know

*

Concerning the variety of food in my home country I am satisfied

- ○ Less
- ○ Evenly
- ○ More

* **How satisfied are you with the look of the food served on board? (e.g. does it look delicious?)**

- ○ Unsatisfied
- ○ Slightly unsatisfied
- ○ Slightly satisfied
- ○ Satisfied
- ○ I don't know

* **Compared to the food in my home country, the food on board looks delicious.**

- ○ Less
- ○ Evenly
- ○ More

---

* **How important is the food's quality for your job-satisfaction and well-being on board?**

- ○ Not Important
- ○ Rather not Important
- ○ Rather Important
- ○ Important
- ○ I don't care

---

* **For the preparation of food, the ship cooks take the different nationalities into account?**

- ○ Disagree
- ○ Slightly Disagree
- ○ Slightly Agree
- ○ Agree
- ○ I don't know

---

* **On board, fresh fruits, salad and vegetables are available?**

- ○ Disagree
- ○ Slightly Disagree
- ○ Slightly Agree
- ○ Agree
- ○ I don't know

---

* **Are there foods that you miss on board?**

- ○ Yes
- ○ No

Which kind of food are you missing on board?

Please read the following statements and rate how much they apply to you!

	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree	Don't know
* I eat less healthy, because it is easy to access unhealthy food!	○	○	○	○	○
* I eat less healthy, because there is no access to healthy food!	○	○	○	○	○
* I eat less healthy, because I am not motivated to eat healthy!	○	○	○	○	○
* I eat less healthy, because I don't know which food is healthy!	○	○	○	○	○
* I eat less healthy, because I don't like the taste of healthy food!	○	○	○	○	○
* I eat less healthy, because there are not enough healthy options (Lack of variety)!	○	○	○	○	○
* I eat less healthy, because my colleagues do not eat healthy!	○	○	○	○	○
* I eat less healthy, because eating healthy is not a masculine thing to do	○	○	○	○	○

When you think about eating: How would you rate the following aspects?

	Not important	Slightly important	Important	Very Important
* Taste of food	○	○	○	○
* Amount of food	○	○	○	○
* Nutritional value	○	○	○	○
* Social contacts	○	○	○	○

* Enough time	○	○	○	○
* Pleasant environment	○	○	○	○

Survey: e-healthy ship - Nutrition - All Seafarers

e-healthy ship - Nutrition - All seafarers

* **Bitte die ID des Probanden eingeben:**

e-healthy ship - Nutrition- All seafarers

How is your knowledge about healthy food?

	0 - Very low	1	2	3	4	5 - Extremely high
Knowledge about healthy food	1					

Are you interested in more information about healthy food?

	I fully disagree	I slightly disagree	I slightly agree	I fully agree	I don't know
* I am interested in more information about healthy food.	○	○	○	○	○

How would you personally rate the following statements about a healthy diet?

A healthy diet...

	I fully disagree	I slightly disagree	I slightly agree	I fully agree	Don't know
contains a lot of meat	○	○	○	○	○
contains a lot of fish	○	○	○	○	○
contains a lot of vegetables and fruits	○	○	○	○	○
contains a lot of cake/cookies/desert	○	○	○	○	○
contains low quantities of drinking water	○	○	○	○	○
contains low quantities of lemonades	○	○	○	○	○
will improve my health	○	○	○	○	○
will be helpful to avoid overweight	○	○	○	○	○
supplies me with energy for my work-out/training	○	○	○	○	○
supplies me with energy for the working					

supplies me with energy for the working day	○	○	○	○	○
makes me more attractive	○	○	○	○	○
is not important	○	○	○	○	○

*** How often do you think vegetables should be a component of the lunch menu?**

○ Never ○ ≤ 1 time a month ○ 2-3 times a month ○ 1-2 times a week ○ 3-5 times a week ○ daily ○ several times daily ○ I don't know

---

*

Which of the following plates shows a healthy plate by recommendation?

A

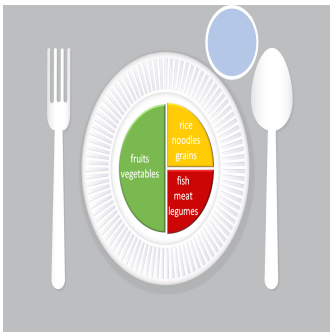
○

B

◉

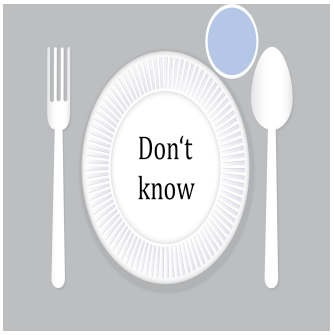
C

○



D

○



E

○

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*

Please check all drinksthat are recommended as part of a healthy diet!
(more than 1 answer possible)

☐ Cola	☐ Water	☐ Fruit juice
☐ Lemonade	☐ Cola Zero and sugar reduced lemonade	☐ Homemade sweetened tea
☐ Ice tea	☐ Coffee	☐ Tea
☐ Other		

Two ships will receive a food intervention.

	Ship A	Ship B	I don't know
* On Ship A meat is offered every day, but no fish. On Ship B meat is offered on 5 days of the week and fish on 2 days of the week. Which one would you prefer?	○	○	○
* On Ship A meat is offered every day. On Ship B meat is offered on 5 days of the week and you can choose your own meat-free meal on the other 2 days. Which one would you prefer?	○	○	○
* Ship A will have the traditional Barbeque. Ship B will have an extended Barbeque	○	○	○

(including meat and grilled vegetables). Which one would you prefer?	○	○	○
* On Ship A there will be fresh fruits as a dessert on 5 days of the week. On Ship B there will be a dessert (for example cake or chocolate pudding) on 2 days of the week. Which one would you prefer?	○	○	○

Plates with pre-cut fruits & vegetables would be placed in the dining rooms.

	Definitely not	Probably not	Probably	Definitely	I don't know
* Would you like this kind of intervention?	○	○	○	○	○
* Would you use it?	○	○	○	○	○

Plates with pre-cut fruits & vegetables would be placed in the dining rooms.

	Definitely not	Probably not	Probably	Definitely	I don't know
* Would you like this kind of intervention?	○	○	○	○	○
* Would you use it?	○	○	○	○	○

Food would be labelled by its nutritional value/healthiness (e.g. traffic lightsystem, green = highly recommended, yellow = moderate recommended, red = notrecommended)

	Definitely not	Probably not	Probably	Definitely	I don't know
* Would you like this kind of intervention?	○	○	○	○	○

Food would be labelled by its nutritional value/healthiness (e.g. traffic lightsystem, green = highly recommended, yellow = moderate recommended, red = notrecommended)

	Definitely not	Probably not	Probably	Definitely	I don't know
* Would you like this kind of intervention?	○	○	○	○	○

Survey: e-healthy ship - Nutrition - 24h-recall

e-healthy ship - Nutrition - 24h-recall

* **Bitte die ID des Probanden eingeben:**

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* **How often do you eat food/s from the kitchen <u>between</u> dinner and breakfast?**

- ○ Never
- ○ Rarely
- ○ Occasionally
- ○ Frequently

---

*

Do you use any supplements (for example protein powder or vitamin pills)?

- ○ Yes
- ○ No

---

* **Are you using protein supplements?**

- ○ Yes
- ○ No

---

* **How often do you use protein supplement/s?**

- ○ ≤ 1 time a week
- ○ 1-2 times a week
- ○ 3-5 times a week

- ○ daily
- ○ several times daily

---

* **Are you using vitamin supplements?**

- ○ Yes
- ○ No

---

* **How often do you use vitamin supplement/s?**

- ○ ≤ 1 time a week
- ○ 1-2 times a week
- ○ 3-5 times a week
- ○ daily
- ○ several times daily

---

* **Are you using minerals supplements?**

- ○ Yes
- ○ No

---

* **How often do you use mineral supplement/s?**

- ○ ≤ 1 time a week
- ○ 1-2 times a week
- ○ 3-5 times a week
- ○ daily
- ○ several times daily

---

* **Are you using multivitamins supplements?**

- ○ Yes
- ○ No

---

* **How often do you use multivitamin supplement/s?**

- ○ ≤ 1 time a week
- ○ 1-2 times a week
- ○ 3-5 times a week
- ○ daily
- ○ several times daily

---

* **Are you using other supplements?**

- ○ Yes
- ○ No

---

* **How often do you use other supplement/s?**

- ○ ≤ 1 time a week
- ○ 1-2 times a week
- ○ 3-5 times a week
- ○ daily
- ○ several times daily

---

*

Do you store foods or drinks for your personal use in your cabin or eat other food that was not supplied by the galley?

Do you buy foods or drinks at the ship store?

- ○ Yes

- ○ No

If yes, How often? What do you buy? How much?

*

Do you eat fish caught by fishing?

- ○ Yes
- ○ No

What kind of fish do you catch? How much of it do you eat? How often do you eat own caught fish?

How much did you weight at the age of...

	Weight in kilograms	Weight in kilograms
* 20 years		-
* 30 years		-
* 40 years		-
* 50 years		-

* **What is your actual weight in kilogramms?**

Survey: e-healthy ship - Nutrition - Use of Apps

e-healthy ship - Nutrition - Use of Apps

* **Bitte die ID des Probanden eingeben:**

*

e-healthy ship - Nutrition - Use of apps

Are you using apps to improve/control your eating behavior?

- ○ Yes
- ○ No

* **If yes, which apps are you using to improve/control your eating behaviour?**

Imagine, you can use digital tools (apps) onboard. Please rate the following statements:

	Fully disagree	Slightly disagree	Slightly Agree	Fully Agree	I don't know
* I am willing to use an app to track my health	○	○	○	○	○
* I am willing to share my data with health professionals	○	○	○	○	○
* I would use the app to self-track my dietary intake	○	○	○	○	○
* I would use the app to check the quality of my dietary intake	○	○	○	○	○
* I would use the app improving my food knowledge (e.g. calories, fat, protein, carbohydrate,…)	○	○	○	○	○
* I would like to preorder my lunch & dinner by using the app	○	○	○	○	○