Diet among oil-workers on off-shore oil installations in the Norwegian sector of the North Sea

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Dietary studies based on 24 h recalls were carried out on four oil installations in the Norwegian sector of the North Sea. Two hundred and three persons were interviewed about what they had eaten the previous 24 h. Food purchased for the installations in the previous 5 months was recorded. Results based on 24 h recalls showed that average daily intake of energy was 12·2 MJ of which 17% came from protein, 44% from fat and 39% from carbohydrate, including 8% from sugar. Meat, vegetables, fresh fruits, seafood (shellfish), french fries, eggs, cream and ice-cream were important components of the diet, while bread, fish and cereals played a minor role. Average daily intake (mg) of nutrients were: calcium 1244, iron 15, vitamin A 1049 μg, vitamin D 4·1 μg, thiamin 1·6, riboflavin 2·2, nicotinic acid 22, ascorbic acid 143. Dietary fibre intake, estimated as unavailable carbohydrate, was on average 19 g, and the average daily intake of cholesterol was 755 mg. Intakes were compared with the Norwegian recommended dietary allowance. Most of the employees chose a diet which when eaten over a longer period of time may contribute to the development of coronary heart diseases (CHD) and thereby increase the morbidity and mortality from CHD in the oil industry.

Diet: Oil workers: North Sea

From the very start of the Norwegian off-shore oil activities in the 1960s rumours have been created of an abundant and unhealthy diet off-shore, and of overeating, obesity and a harmful lifestyle. No exact information existed, however, which could either prove or disprove these rumours and give indications of the nutrition situation off-shore.

An earlier study at the Statfjord Field in the North Sea showed that many of the workers were exposed to severe psychic stress in the form of noise, heat, depression and isolation (Hellesøy, 1984). Like diet, psychic stress has been mentioned as an important risk factor for coronary heart diseases (CHD; World Health Organization, 1982; Ernest & Levy, 1984). Given this high exposure to different risk factors it was important to describe the dietary profile and thereby determine whether the oil workers were also exposed to dietary risk factors. Unfortunately there is still no information on the CHD morbidity and mortality of Norwegian oil-workers.

The present paper describes the diet among oil-workers on selected oil installations in the Norwegian sector of the North Sea. Adaptation strategies to wide food choice and the impact of working conditions on their food habits have been discussed elsewhere (Østgård, 1990).

EXPERIMENTAL

Sample

At the time of the study about 12000 man-years were linked to oil activities in the Norwegian sector of the North Sea. About 67% of these were on relatively large permanent

Table 1. *Average food intake* (g/person per d and g/10 MJ) for Norwegian oil-workers (n 203) on three installations in the North Sea†*

(Mean values with their standard errors)

Type of food	g/person per d		g/10 MJ	
	Mean	SEM	Mean	SEM
Bread	126	5·2	109	4·3
Cakes and sweet biscuits	53	4·6	42	3·4
Potatoes	114	8·5	97	7·3
French-fried potatoes	26	4·1	18	2·9
Vegetables	162	9·3	137	7·7
Fresh fruits	171	12·7	148	10·8
Canned fruits	75	8·1	59	5·9
Meat	268	12·6	226	9·8
Fish	45	6·1	38	5·4
Shellfish	20	3·1	16	2·4
Egg	42	3·5	35	2·9
Whole-fat milk	320	27·5	250	19·5
Low-fat milk	150	25·6	126	20·3
Cream, sour/ice-cream	88	8·4	67	6·1
Cheese	22	2·4	20	2·2
Edible fats (butter, margarine, mayonnaise etc.)	67	4·9	53	3·0
Sugar, honey, etc.	10	1·3	8	1·1
Fruit juice/cider	143	18·4	129	15·6
Soft drinks	117	19·1	103	16·6
Tea	52	11·2	43	13·2
Coffee	1079	51·6	986	57·2

* Edible part.
† For details of procedures, see pp. 11–13.

installations, about 25% on small movable installations (floating rigs) and less than 8% on supply boats and so on (Ministry of Local Government and Employment, 1985, personal communication).

Installations were selected according to size, location and catering system. Four installations were selected on which about 840 persons in total were employed, distributed on: rig 1 (about eighty persons), rig 2 (about seventy persons), installation 1 (about 500 persons) and installation 2 (about 190 persons). There was some fluctuation in the number of persons at any time at the installations.

The different installations were situated along the Norwegian Continental Shelf: rig 1, north of Norway in the Arctic Ocean; rig 2, outside the North Western coastline; installation 1 at the Statfjord Field west of the coastline; installation 2, south in the Norwegian sector close to the Danish sector. The catering on rig 2 was undertaken by the operating company itself, while the other installations engaged catering firms.

It was the purpose to include in the sample all workers (if possible) who were working at the platform during the survey. Nobody, however, was forced to participate in the survey. Information meetings were held where the aims and methodology of the survey and time required were explained. The workers were urged to participate both by the two nutritionists who were undertaking the survey and by the health workers at the installations. Only seven of the 210 persons invited refused to participate in the study. This gives a response rate of 97%.

Questionnaire interviews with the workers could only be carried out on three installations (rigs 1 and 2 and installation 2). The sample for questionnaire interviewing was 367, of

Table 2. *Average intake of energy and nutrients (/person per d and /10 MJ) of Norwegian oil-workers* (n *203*) *on three installations in the North Sea**

(Mean values with their standard errors)

	per person/d		per 10 MJ	
Energy and nutrient	Mean	SEM	Mean	SEM
Energy (MJ)	12·2	0·29	—	—
Protein: g	121	2·9	102	1·6
% of total energy	17	0·3	—	—
Fat: g	145	4·7	116	1·6
% of total energy	44	0·6	—	—
% of total energy from saturated fatty acids	17	—	—	—
% of total energy from PUFA	9	—	—	—
Total carbohydrate: g	275	7·1	228	3·7
% of total energy	39	0·6	—	—
Sugar: g	62	3·5	50	2·4
% of total energy	8	0·4	—	—
Calcium (mg)	1244	46	1028	31
Iron (mg)	15	0·38	12	0·25
Vitamin A (μg)	1049	37	860	24
Thiamin (mg)	1·6	0·05	1·3	0·03
Riboflavin (mg)	2·2	0·06	1·8	0·04
Nicotinic acid (mg)	22	0·7	17	0·3
Ascorbic acid (mg)	143	7·8	121	6·5
Vitamin D (μg)	4·1	0·24	3·3	0·18
Cholesterol (mg)	755	26	622	17
Dietary fibre (g)	19	0·6	16	0·5

PUFA, polyunsaturated fatty acids.

* For details of procedures, see pp. 11–13.

which 203 were interviewed. The rest (164) were off duty, most of them sleeping at the time of the interviews, and seven refused to take part in the survey. Of the interviewed there were 194 men and nine women. The age varied from 18 to 58 years. The sample was fairly young, 65% being between 25 and 40 years of age. Only 8% had been employed in the oil industry for more than 10 years, while 47% had been employed for 3–6 years.

Methods

Dietary information was obtained by two different methods. The availability of food (g/person per d) was calculated on the basis of invoices of food purchased over a 5-month period and the total number of man-days during that period. Information on food intake was collected in personal interviews using standard 24 h recall, and additional questions regarding underlying factors influencing the diet. The information was coded by food item and amount and analysed by a nutrient database and computer program developed by the Section for Dietary Research, University of Oslo.

Food models were prepared in the kitchen each day before the interviews. The models included all items in the menu of the day. The different cups, glasses and bottles with different soda drinks, juices etc. in the restaurant were used when determining volume of drinkables.

Key informant interviews with catering and health personnel at the installations were also conducted. These findings were used in the discussion with the workers after the survey, in information leaflets, and some have been reported elsewhere (Østgård, 1990). Interviewing took place between March and October 1985.

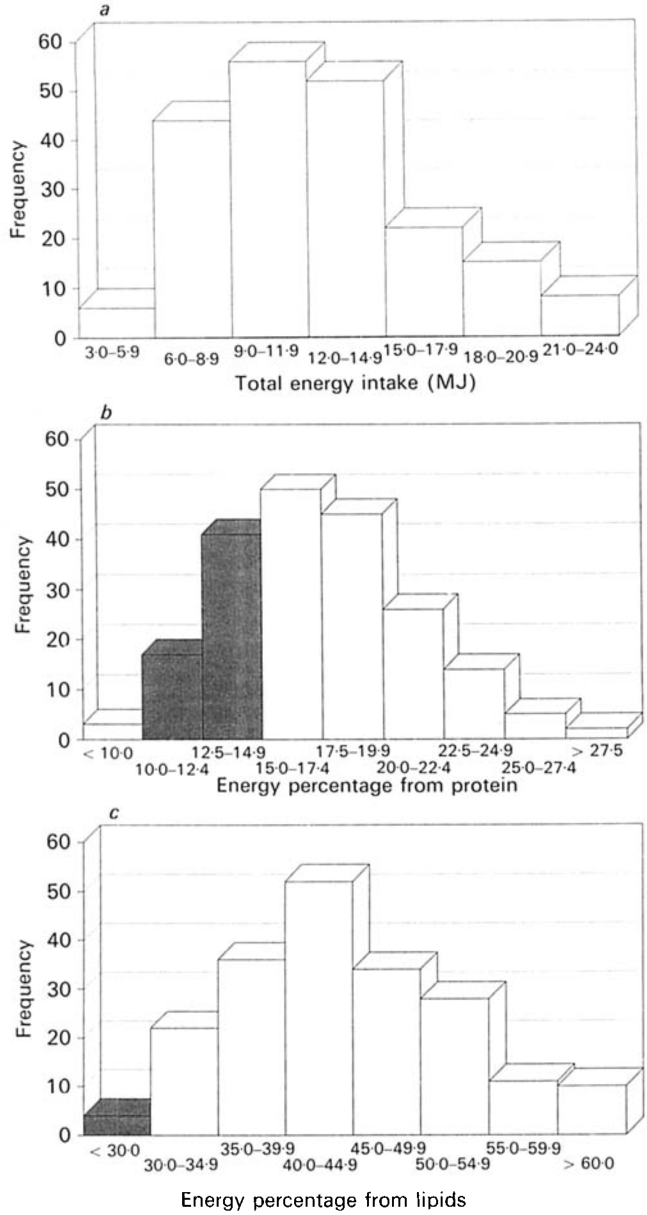

Fig. 1 (*a–c*). For legend see opposite.

RESULTS

Intake

The amounts of the different foods eaten are summarized in Table 1. At the installations much meat, eggs, french fries and seafood (shellfish) was eaten. The intakes of vegetables, fresh fruit and berries, cream and ice-cream were very high on off-shore installations. The consumption of bread and cereals was, however, low compared with that recommended by the (Norwegian) National Nutrition Council (1989). The intake of edible fat was high, but sugar intake was at an acceptable level (below 10% of total energy intake).

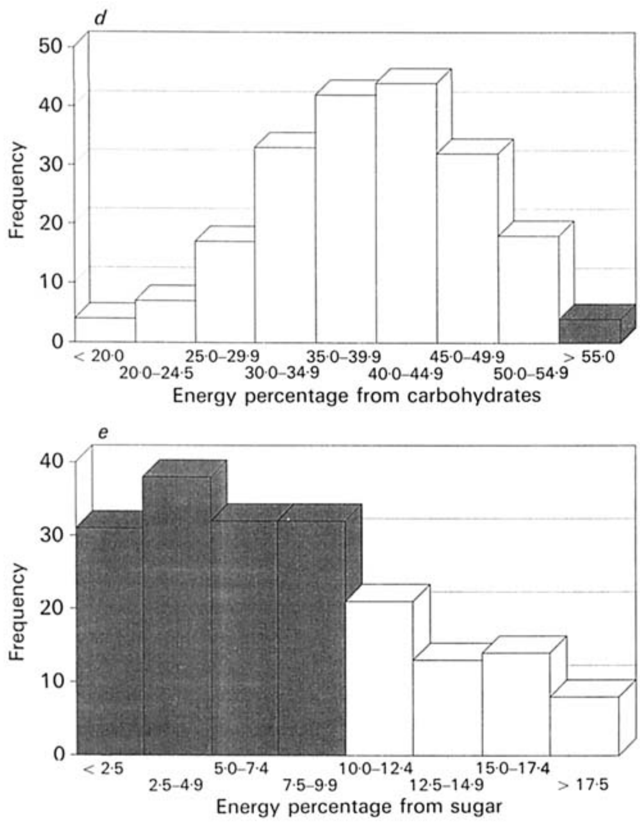

Fig. 1. Distribution of energy intake (MJ) for total energy (*a*) and percentage energy intake from protein (*b*), lipids (*c*), carbohydrates (including sugar) (*d*) and sugar (*e*) for 203 Norwegian oil-workers on three installations in the North Sea. Quantities do not correspond(□) or do correspond (▩) with the Norwegian recommended dietary allowance on the day of the survey. For details of procedures, see pp. 11–13.

Coffee was the most popular beverage, amounting to more than 1 l/person per d. The oil-workers also consumed much fruit juice, soft-drinks and alcohol-free beer (alcohol is strictly forbidden on the installations). The total intake of liquid from food and drinks on the installations was 2·8 l/person per d.

Energy and nutrient intakes are summarized in Table 2. The results show that the energy contribution from fat and protein was high, and also that the intakes of ascorbic acid and cholesterol were very high.

The polyunsaturated (PUFA):saturated fatty acids ratio in the diet of the oil-workers was 0·50. In a dietary study among Norwegian men on shore (Blaker *et al.* 1988) this ratio was 0·38.

The most important sources of dietary fat were edible fat (32%), meat (26%), milk (10%) and milk products except butter (12%). Dishes based on mayonnaise made up an unusually high percentage of the fat (11) which resulted in the high intake of PUFA. The reason for the relatively low contribution of fat from meat in spite of the high meat consumption is that most of the meat was lean (beefsteaks etc.).

As indicated in Fig. 1(*a–e*) the dietary intake varied considerably from person to person. The energy intake varied from 3·7 to 23·8 MJ/d, i.e. some individuals ate more than six times as much as others on the day of the interview (Fig. 1(*a*)). Sugar had the highest variation in intake, from zero to more than 25% of the energy. Protein (Fig. 1(*b*)) and fat (Fig. 1(*c*)) also showed high variations, as the highest intake was three times that of the lowest.

Fig. 1. also illustrates how many of those interviewed had an intake corresponding to the Norwegian recommended dietary allowance (RDA) on the day of the survey. The smallest percentage was for carbohydrates (RDA 55–60% of the total energy) and fat (RDA below 30% of the total energy). Concerning the intake of other nutrients relative to the RDA, 36% had an intake of vitamin D above recommendations (5 μg/d) and 10% consumed the recommended amounts (or above) of dietary fibre (at least 3 g/MJ) on the day of the survey.

Food availability

The amounts of foods purchased by the catering services at the installations are summarized in Table 3. Table 4 shows the average daily availability of energy and nutrients over a 5-month period. The most striking feature is the very high availability of energy and the high percentage of energy from fat.

DISCUSSION

The intakes of nutrients on the day of the survey were liberal compared with the RDA of the National Nutrition Council (1989) in Norway. In fact the intakes of calcium and ascorbic acid were twice the recommended values. The energy intake was quite high, reflecting partly the young average age in the sample. Strong negative features were the high percentage of the energy from fat (44), the high cholesterol intake (755 mg) and the low intake of dietary fibre (19 g). The reason for this was the high intake of animal foods.

The high intake of cholesterol was mostly due to the consumption of meat and eggs which contributed 51 and 32% respectively. Milk contributed 17% of the cholesterol in the diet.

Because so little bread, cereals and potatoes were eaten, both the energy contribution from carbohydrates and the amount of dietary fibre were low. The intake of dietary fibre would have been very low if the intake of vegetables had not been so high.

A positive feature of the off-shore diet was the high intake of vegetables, fruit, berries and fruit juices. This explains the very high intake of ascorbic acid.

Comparison of the data from 24 h recall (Tables 1 and 2) and food availability (Tables 3 and 4) shows a considerable difference in terms of amount, particularly in energy. In fact it indicates a waste of about 50% of the food (in terms of energy), but the waste was not the same for the various food items. Comparing the amount of food available per 10 MJ with food intake per 10 MJ for milk, for example, the amount of total milk per 10 MJ is higher in food intake (376 g, Table 1) than in food available (233 g, Table 3). This is reflected in Tables 2 and 4 where the amount of Ca and riboflavin per 10 MJ is higher for food intake. Low-fat milk was introduced into Norway in the last part of 1984, which coincides with the start of the 5-month period for collection of food availability data. The consumption of low-fat milk was low during the first few months, but increased gradually throughout 1985. The contribution of fat to the percentage energy decreased from about 47% for food available to about 44% for food intake. The energy share from protein and carbohydrate decreased accordingly in the values based on food availability.

The reliability of dietary data from 24 h recall can be questioned. Comparison of the results from the 24 h recall and food availability based on invoices over the 5-month period indicates that the data on nutrient intake per 10 MJ at the off-shore installations are reliable. The reason for this is that an off-shore platform is isolated from other sources of foods.

Table 3. *Average food availability* (g/person per d and g/10 MJ) for Norwegian oil-workers on three installations in the North Sea*†

Type of food	g/person per d Mean	g/10 MJ Mean
Cereals and cereal products‡	192	76
Potatoes	269	107
French-fried potatoes	84	33
Vegetables	396	157
Fresh fruits	269	107
Canned fruits	71	28
Meat	568	226
Fish	83	35
Shellfish	31	12
Egg	112	45
Whole-fat milk	472	187
Low-fat milk	115	46
Cream, sour/ice-cream	169	67
Cheese	65	26
Edible fats (butter, margarine, mayonnaise, etc.)	136	54
Sugar, honey, etc.	63	25
Fruit juice/cider	238	95
Soft drinks	172	67

* Calculations are based on edible part of total purchased food over a 5-month period.
† For details of procedures, see pp. 11–13.
‡ Cakes and sweet biscuits in Table 1 were produced at the installations and are thus included in the values for cereals and cereal products, egg, edible fats and sugar.

Table 4. *Average availability of energy and nutrients for Norwegian oil-workers on three installations in the North Sea over a 5-month period**

Energy and nutrient	per person/d
Total energy (MJ)	25
Part of energy from:	
Protein (%)	16
Lipids (%)	47
Total carbohydrate (%)	37
Nutrient content (/10 MJ):	
Calcium (mg)	837
Iron (mg)	12
Vitamin A (μg)	1190
Thiamin (mg)	1·3
Riboflavin (mg)	1·6
Nicotinic acid (mg)	19
Ascorbic acid (mg)	121
Vitamin D (μg)	4·2
Cholesterol (mg)	631
Dietary fibre (g)	15

* For details of procedures, see pp. 11–13.

The problem is the high discrepancy between total energy availability and energy intake. As described by Østgård (1990), a large buffet was prepared at every platform four times each 24 h. This inevitably led to a high waste of food, which was observed by the interviewers. The catering personnel also admitted that the waste, primarily due to this, was probably about 50% of the food available.

The data are considered to give a good picture of the diet at oil installations in the Norwegian sector of the North Sea. The workers maintained that the diet at different installations was quite uniform, with only minor variations. There are few catering firms operating, and all have an assortment of different foods and dishes which have to meet quite uniform standards set by the oil companies.

The biggest variation is probably in the preparation of the dishes. This is important since all workers have to eat what the cooks prepare. The variation in preparation is most probably due to the difference in professional training, competence and the nutritional interest of the cooks and chefs. As could be observed there were considerable variations, from an almost indifferent or hostile attitude towards discussing nutritional considerations in catering activities, to a keen nutritional interest and much effort was made such as in preparation, display, and recommendations of dishes to the crew in order to promote a nutritionally favourable food choice.

Foreign workers maintained that the standard of the catering at the Norwegian installations was high compared with that of other sectors in the North Sea. Very few workers complained about the food, and if any did it was mostly about the abundance and wide choice of food and of the high fat content of certain dishes. Many oil-workers maintained, however, that they were eating more healthily when off-shore than at home. From the very ample choice it was no problem, if one had the knowledge and will, to eat very healthily from a nutritional point of view while off-shore, as several oil-workers did.

There were many positive features of the diet of the oil-workers when they were at the installations but, as the present study shows, some of the rumours about the negative side of the diet were correct. Many oil-workers had too high an intake of fat and cholesterol, too little fibre in their diet, a high meat consumption and a low consumption of fish; a diet which may have influenced their levels of blood lipids and increased their risk for CHD (Samuel *et al.* 1983).

CHD is the major cause of death in Norway (Central Bureau of Statistics, 1990). Over the past 10 years the diet has changed substantially in Norway. At the wholesale consumption level the contribution of energy from fat has decreased from 40% in 1975 to 36% in 1985. At the same time a decrease in mortality from CHD can be observed (National Nutrition Council, 1990*a*).

This dietary study shows that the oil-workers consume more protein, more fat, more cholesterol, and less carbohydrate than comparable groups of men on-shore (Solvoll *et al.* 1985; Blaker *et al.* 1988). From a dietary point of view, therefore, the oil-workers seem to have an increased risk for CHD.

There are no CHD mortality and morbidity data for Norwegian oil-workers. Health workers at the installations and medical officers employed by the oil companies maintain, however, that they can see an increasing rate of CHD among oil-workers in the North Sea (Chief Medical Officer in Statoil D. Andreassen, 1990, personal communication).

The most logical group with which to compare the oil-workers is that of men working on boats. Several studies show that seamen and naval officers have a high risk of CHD, high rate of mortality and ill-health linked to too much fat in the diet, insufficient exercise and excessive smoking. They are also away from their families, friends and the local environment on-shore over a fairly long period (Mundal *et al.* 1982; Tenfjord *et al.* 1983; Brochmann *et al.* 1985).

These are all characteristics which are similar to those displayed by the oil-workers. At the same time the stresses imposed on the oil-workers by the means of transport to the platforms (helicopter, often in very bad weather), working in a dangerous and stressful environment (including noise and heat) and exposure to depressions and isolation are probably increasing the risk for CHD among the oil-workers in the North Sea (Hellesøy, 1984). This may be reflected in the statistics by increased figures for CHD morbidity and mortality which will eventually be prepared when the database is adequate. This occurs at a time when the mortality from CHD in Norway in general is decreasing (National Nutrition Council, 1990*b*).

REFERENCES

Blaker, B., Solvoll, K. & Lund-Larsen, K. (1988). *Kosthold i vestre Toten 1987* (The diet in the western part of Toten in 1987). Rapport no. 6 1988. Oslo: Section for Dietary Research, School of Medicine, University of Oslo.

Brochmann, J. H. H., Larsen, Ø. & Tenfjord, O. W. (1985). Å Være til sjøs – et yrke og en livsform i forandring (To work as a sailor – a profession and way of life in change). *Nordisk Medicin* **100**, 54–59.

Central Bureau of Statistics (1990). *Dødsårsaker 1989* (Causes of death 1989). Statistisk ukehefte nr. 49. Oslo: Central Bureau of Statistics of Norway.

Ernst, N. D. & Levy, R. I. (1984). Diet and Cardiovascular Diseases. In *Present Knowledge in Nutrition*, 5th ed. pp. 725–739. Washington DC: Nutrition Foundation.

Hellesøy, O. H. (1984). *Arbeidsplass Statfjord* (Workplace Statfjord). Oslo: Universitetsforlaget.

Mundal, R., Erikssen, J. & Rodahl, K. (1982). Latent ischemic heart disease in sea captains. *Scandinavian Journal on Environmental Health* **8**, 178–184.

National Nutrition Council (1989). Anbefalinger for ernæringsmessig sammensetning av kostholdet (RDA) (Recommendations concerning the nutritional composition of the diet). Oslo: Statens Ernæringsråd.

National Nutrition Council (1990*a*). *The Norwegian Diet and Nutrition and Food Policy*. Oslo: National Nutrition Council.

National Nutrition Council (1990*b*). *Sammendrag av utviklingen i norsk kosthold* (Summary of the development of diets in Norway). Oslo: Statens Ernæringsråd.

Østgård, L. I. (1990). Food habits among Norwegian offshore oilworkers: Adaptation to spectrum and abundance of food choice. *Bibliotheca 'Nutritio et Dieta'* **45**, 165–175.

Samuel, P., McNamara, D. J. & Shapiro, J. (1983). The role of diet in the etiology and treatment of atherosclerosis. *Annual Review of Medicine* **34**, 179–194.

Solvoll, K., Løken, E. B., Grønn, M. & Andersson, E. (1985). *Kosthold i Vestre Toten* (The diet in the western part of Toten). Rapport no. 2 1985. Oslo: Section for Dietary Research, School of Medicine, University of Oslo.

Tenfjord, O. W., Borchgrevink, Chr. F., Vaa, T., Vellar, O. D. & Aarø, L. E. (1983). Risikofaktorer for koronary hjertesykdom hos sjømenn (Risk factors for coronary heart disease among sailors). *Tidsskrift for Norsk Lægeforening* **103**, 2312–2316.

World Health Organization (1982). *Prevention of coronary heart disease*. Technical Report Series no. 678. Geneva: WHO.

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