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**THE USE OF TOBACCO PRODUCTS
AMONG NAVAL SPECIAL WARFARE PERSONNEL**

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NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
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The Use of Tobacco Products Among Naval Special Warfare Personnel

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SUMMARY

Problem.

As smokeless tobacco use in the general Navy population increases, Navy physicians also indicate significant use of these products by Naval Special Warfare Sea, Air, Land (SEAL) personnel. SEALs appear to ignore the health effects of smokeless tobacco products. With smoking clearly established as a health risk, it is important to recognize the possible acute detrimental effects of the use of tobacco products in the diving environment. It is also possible that nicotine, or more likely nicotine withdrawal during a mission, could have detrimental effects on performance.

Objective.

Literature studying the effects of smoking is extensive. However, studies on the effects of smokeless tobacco products are scarce. The primary objective of this study was to document the extent and character of tobacco use in the Navy SEAL population. The long-term objective is to raise the SEAL's awareness of the problem and suggest interventions.

Approach.

Tobacco product use questionnaires were completed by 210 U.S. Naval Special Warfare Sea, Air, Land (SEAL) personnel. Survey questionnaires were used to collect data on smoking and use of smokeless tobacco products among SEAL populations, both on the east and west coasts. Age groups were compared using Pearson chi-square. Comparisons between the SEALs data and previously collected data from the general Navy population were made using Fisher's exact test for 2X2 tables, or independent t-tests, as appropriate.

Results.

Results indicate a relatively high use of smokeless tobacco products in this population. SEALs have a lower prevalence of cigarette smoking (7%) versus that of the general Navy population (39%). However, SEALs show a significantly greater use of smokeless tobacco (33% versus 17%). This occurs despite the relatively high fitness orientation of this group.

Conclusions.

The data indicate that far fewer SEALs smoke cigarettes than do members of the general Navy population. However, significant smokeless tobacco use exists in the SEAL population; among SEALs, the rate of smokeless tobacco use was twice that of the general Navy population during a 12-month period. An intervention to correct this condition and potentially improve short-term performance and long-term health is indicated.

INTRODUCTION

The use of smokeless tobacco in the United States is reportedly increasing, with the predominant increase occurring among young males (Brownson, DiLorenzo, Van-Tuinen, & Finger, 1990; Bruerd, 1990; Christen, McDonald, Olson, & Christen, 1989; Ernster et al., 1990; Glover, Laflin, Flannery, & Albritton, 1989; Greer, 1989; Leopardi, Poulson, Neiger, Lindenmuth, & Greer, 1989; Orlandi & Boyd, 1989). Informal surveys of physicians responsible for the care of Naval Special Warfare Sea, Air, Land (SEAL) personnel indicate significant smokeless tobacco product use by this population. Given the well-established health risks of tobacco products and the possible acute interactions with the diving environment, tobacco use in this population is clearly undesirable. To define the extent of the problem, tobacco product use survey questionnaires were distributed to both east coast and west coast SEAL teams. The results are presented and compared to data collected from the general Navy population.

Smoking has been clearly established as a health risk. The literature examining the effects of tobacco use is extensive. However, information regarding the use of smokeless tobacco and its effects is substantially less (Glover et al., 1986; Landers et al., 1992). According to Landers (1992), there are fewer than 30 studies concerning smokeless tobacco, of which only a third examine its effects on the physiology and performance of the user. Although the effects of smokeless tobacco use have not been as extensively investigated, data indicate that this method of exposure to tobacco also presents significant risks. In a report published in 1986, the Advisory Committee to the Surgeon General concluded: (a) there is a strong link between smokeless tobacco use and cancer; (b) the associated nicotine exposure and addiction is similar to that of cigarette smoking; and (c) the nicotine-associated health risks of coronary artery disease, peripheral vascular disease, hypertension, and peptic ulcer disease reported with smoking will probably be seen with smokeless tobacco use.

Recent reports associate smokeless tobacco use with leukoplakia of the oral mucosa, a possible precursor to cancer (Grady et al., 1990); nuclear alterations in oral mucosa cells (Livingston, Reed, Olson, & Lockey, 1990); oral cancer (Ahmed & Islam, 1990); cancer of the esophagus (Rao, Sanghvi, & Desai, 1989); and hypercholesterolemia (Tucker, 1989).

Smokeless tobacco contains significantly higher levels of cancer-causing tobacco-specific nitrosamines (TSNA) than any other consumer product (Peterson, Barreto, & Brunemann, 1990). Snuff users' TSNA hemoglobin adducts are reported to be over six times greater than those of smokers and almost 20 times higher than nonsmokers (Carmella et al., 1990).

Most cancers are considered a long-term problem, rarely appearing until middle age or later, and are unlikely to interfere with SEAL mission performance.

However, such sequelae significantly affect the Navy because they may ultimately place a large economic burden on the Navy medical system.

Nicotine is probably the most studied bioactive chemical in tobacco. It has a broad range of effects on the body, interacting with the autonomic ganglia to stimulate the release of both norepinephrine and acetylcholine in the peripheral nervous system. This initial stimulation is followed by subsequent depression, resulting in a variety of physiological responses. Heart rate may be either increased or decreased. Blood pressure is most often increased (Taylor, 1990). With repeated exposure, the sympathoadrenal response to nicotine is blunted. This tolerance carries over to suppression of the normal sympathoadrenal response to stress (Van Loon, Kiritsy-Roy, Brown, & Bobbitt, 1987), an effect which might impair normal physiological responses in stressful situations. Nicotine also interacts with the central nervous system, altering neurotransmitter release and affecting the hypothalamic hormones (Rowell, 1987). Chronic tobacco smoking decreases cutaneous blood flow at rest and decreases the hyperemia seen after a period of ischemia (Richardson & Hyde, 1987). This nicotine effect may occur with smokeless tobacco use as well. It is possible that these vascular effects could interact negatively with cold water diving by interfering with the normal alternation of vasodilation and vasoconstriction, as observed in the hands of people exposed to severe cold (Pozos, Israie, McCutcheon, Wittmers, & Sessler, 1987). Nicotine also increases hand tremor, an effect to which one does not develop tolerance and which, in some tasks, might impair performance (Jaffe, 1990).

Chronic smokers who refrain from smoking show impaired performance in both speed and accuracy on some cognitive tasks; this impairment usually persists for over a week. The fact that nicotine gum reverses the performance impairment indicates that this effect relates to nicotine addiction and should therefore be present with smokeless tobacco use as well (Pickworth, Herning, Snyder, & Henningfield, 1987). Generally, divers would have to abstain from tobacco use during missions; therefore, these data suggest that the performance of those with smokeless tobacco habits might be impaired. Other characteristic symptoms of nicotine withdrawal, such as irritability, anxiety, drowsiness, and gastrointestinal complaints (Jaffe, 1990) might also interfere with performance on longer missions.

Nicotine is in some sense a central nervous system stimulant. Repeated nicotine exposure increases the number of central nervous system nicotinic receptors and increases the stimulant effects of nicotine on behavior in rats (Ksir and Hakan, 1987). However, attempts to use this agent as a stimulant to reverse sleep-deprivation-related performance impairment in nonsmokers have been unsuccessful (Newhouse, Fertig, Penetar, Sunderland, & Belinki, 1989). This suggests that the improvements seen in the performance of smokers relate only to reversal of a nicotine-related deficit without any above-baseline enhancement.

Nicotine increases the metabolic rate during rest and especially during exercise (Perkins, Epstein, Marks, Stiller, and Jacob, 1989). Therefore, nicotine-addicted personnel involved in prolonged high-physical-effort missions might require more food to maintain performance.

Perkins et al. (1990) found that the effects of nicotine (increased heart rate and blood pressure) are additive with the effects of exercise. This study employed only light physical activity. It is conceivable that with intense physical activity there might be a predisposition to actual cardiovascular events, particularly when the additional cardiovascular effects of diving are added. In another study, Edwards et al. (1987) reported that smokeless tobacco users exhibited increased heart rates (8 to 9%) when performing perceptual-motor tasks. The increases in heart rate occurred within three to five minutes of tobacco use. However, no improvement was found in reaction time, movement time, or total response time among the subjects.

Finally, nicotine exposure alters the rate at which the body metabolizes various drugs. For example, tobacco users may require higher doses of opiates to relieve a given amount of pain (Jaffe, 1990), an effect which could impact battlefield medical treatment.

In summary, both smoking and smokeless tobacco use are established health risks. Additionally, tobacco use directly or indirectly via nicotine withdrawal, may impact performance. As the Navy's most elite force, SEALs' tobacco use is especially undesirable. The purpose of this survey was to document the extent and character of tobacco use within the SEAL population.

METHODS

A tobacco use survey questionnaire (Appendix A) was adapted from a questionnaire used in previous Naval Health Research Center (NHRC) studies of other military populations (Conway et al., 1989). Adaptations were made to collect more information about smokeless tobacco, which was expected to be the predominant tobacco product used by Navy SEALs.

Questionnaires were distributed to both east coast and west coast SEAL teams (seven SEAL teams total). Of the 210 respondents, the mean age was 26 ± 5 years (range 19 to 50). Age group categories were compared using Pearson chi-square. Comparisons with data from the general Navy population were made using Fisher's exact test for 2X2 tables, or independent t-tests, as appropriate.

RESULTS AND DISCUSSION

Questionnaire results are summarized in Appendix B. The actual number of answers for specific questions varies slightly due to missing data. Pipe and cigar use involved a trivial number of subjects (5% or less); therefore, these

data are not included. Sixty-two percent (62%) of respondents had not used any form of tobacco for as long as a year. Of the 38% who reported at least one year of tobacco use, the largest portion (41%) have used tobacco over an extended period (≥ 10 years). The average duration of use (excluding the nonusers) was approximately seven years. Of the 46% who reported using tobacco products at any time, the largest portion (13%) first used tobacco between ages 15 and 17.

Most questionnaire responses from the different age group categories were similar. Older SEALs reported significantly more years of tobacco use than younger subjects (Pearson chi-square = 119.734, DF = 52, $p < 0.001$). Also, up until one year prior to answering the questionnaire, the younger SEALs used smokeless tobacco (chewing tobacco or snuff) significantly more frequently than the older SEALs (Pearson chi-square = 35.180, DF = 21, $p = 0.027$), with a similar trend within the last year ($p = 0.055$).

Appendix C presents a comparison of tobacco use data from a 1988 study of the general Navy population (Conway et al., 1989). The sizes of the two study populations differed greatly (Conway et al. surveyed over 3,000 subjects); thus, to facilitate comparisons, the data are presented as percents. For comparison to data from the general Navy "years of tobacco use," the responses to the categorical questions were treated as actual numbers (e.g., a selection of "10" was treated as the number 10 in the calculation of the mean). Thus, the numbers presented here should be considered approximate (e.g., the selection of "10" might actually have meant anywhere from 10 to 14). Subjects without a history of tobacco use were excluded from the years-of-tobacco-use calculations.

More SEALs had a history of smokeless tobacco use than the general Navy population (33% versus 17%, respectively). In contrast, significantly more of the general Navy population reported being current cigarette smokers (39% versus 7%, respectively, $p < 0.001$). Tobacco users in the general Navy population had been using tobacco longer than the SEAL population ($\bar{X} = 9.4$ years versus 7.4 years, respectively, $p = 0.01$). Again, this is probably a result of the older age of the general Navy group. Subjects in the general Navy survey who fell in the age range of the SEALs had years of use similar to the SEALs.

There were proportionally more older subjects in the general Navy population (mean age 29.4 ± 7.3 years) previously surveyed (Conway et al., 1989). However, the comparisons should still be valid, given that the responses from the overall general Navy group closely resemble those from the 20-to-29-year-old age bracket (the group whose ages match those of most of the SEAL participants) for most questions. Those responses where age factors may have affected results are pointed out. The SEAL population surveyed showed a lower incidence of current smokers than the general Navy population (see Appendix B and Conway et al., 1989), as might have been expected in a group with heavy emphasis on physical fitness. Seven percent (7%) reported that they were current smokers; only 3% had smoked cigarettes within the last 30 days. Those that did smoke consumed very

few cigarettes. Thirty-nine percent (39%) of the general Navy population were current smokers, and smoked a varying number of cigarettes per day.

However, smokeless tobacco users show a very different pattern. Only data from the past 12 months (prior to filling out the questionnaire) are available from the general Navy population study for smokeless tobacco use comparisons. These data show that only 17% used smokeless tobacco, with 6% being everyday users. Thirty-four percent (34%) of SEAL respondents used smokeless tobacco within the past year, and 18% were daily users. In comparison, a 1988 survey administered to Major League baseball players (average age 27.4 years) reported that 34% of the respondents were current users of smokeless tobacco, and 15% of these also smoked cigarettes (Connolly et al., 1988). This suggests that Navy SEALs and professional baseball players may not relate smokeless tobacco use to possible impairment of physical performance. Nicotine might interact negatively with exercise and/or diving physiology (see Introduction). Likewise, nicotine withdrawal could cause problems during dives. As to chronic health effects, this population of young adults is aware of the risks they are taking, but suffer from the delusion of immunity ("it won't happen to me").

The same percentage of SEAL respondents (25%) reported having tried cigarettes and chewing tobacco at some time. However, only 7% of the SEALs are currently cigarette smokers, while 17% chew. Twenty percent (20%) previously used snuff regularly, and 16% are still users. It appears that SEALs tend to stop using cigarettes before or after entering the SPECWAR program and either begin or continue to use smokeless tobacco. Of the SEALs who used a tobacco product within the year prior to the survey, the majority used smokeless tobacco (23% chewing tobacco and 17% snuff). Only 12% smoked cigarettes during that period; 5% smoked cigars and 1% used pipes. It was common for both the cigarette smokers and smokeless tobacco users to be everyday users.

CONCLUSIONS

1. There appears to be significant smokeless tobacco use, but fewer smokers, among Naval Special Warfare Personnel, compared to the general Navy population.
2. Among SEALs during a 12-month period, the rate of smokeless tobacco use was twice that of the general Navy population.
3. Educational intervention is recommended to decrease smokeless tobacco use among Naval Special Warfare Personnel.

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APPENDICES

APPENDIX A
TOBACCO USE SURVEY QUESTIONNAIRE

TOBACCO USE SURVEY

NAME _____ AGE _____ SOCIAL SECURITY NUMBER _____

Everything in this questionnaire is confidential. It will not appear in your record. Please be as accurate as possible.

1. How many years have you used (or did you use) tobacco on a regular basis? Do not count any time when you quit using tobacco.

- | | |
|---|-----------------------------------|
| <input type="checkbox"/> Never used tobacco | <input type="checkbox"/> 7 years |
| <input type="checkbox"/> Less than 1 year | <input type="checkbox"/> 8 years |
| <input type="checkbox"/> 1 year | <input type="checkbox"/> 9 years |
| <input type="checkbox"/> 2 years | <input type="checkbox"/> 10 years |
| <input type="checkbox"/> 3 years | <input type="checkbox"/> 15 years |
| <input type="checkbox"/> 4 years | <input type="checkbox"/> 20 years |
| <input type="checkbox"/> 5 years | <input type="checkbox"/> 30 years |
| <input type="checkbox"/> 6 years | |

2. At what age did you first start using tobacco products regularly?

- Never used tobacco
- Under 12 years
- 12 to 14
- 15 to 17
- 18 to 20
- 21 or older

3. Have you ever done any of the following?

	Never	Currently	If you quit, how long ago did you quit?	
			Years	Months
Smoked Cigarettes				
Smoked Cigars				
Smoked a Pipe				
Chewed Tobacco				
Used Snuff				

4. From the time you started using tobacco up until one year ago, about how often did you do the following?

	Never	Once or Twice	3-6 Days	7-11 Days	Once a Month	2-3	1-2	3-4	5-6	About Every Day
						Days per Month	Days per Week	Days per Week	Days per Week	
Smoked Cigarettes										
Smoked Cigars										
Smoked a Pipe										
Chewed Tobacco										
Used Snuff										

5. From the time you started using tobacco up until one year ago, how many times per day did you dip or chew, on the average?

- N/A 1 2 3 4 5 6 7 8 9+

6. From the time you started using tobacco up until one year ago, how many cigars or pipe bowls per day did you smoke, on the average?

- N/A 1 2 3 4 5 6 7 8 9+

7. From the time you started using tobacco up until one year ago, how many cigarettes per day did you smoke, on the average?

- | | |
|--------------------------------|-------------------------------------|
| <input type="checkbox"/> N/A | <input type="checkbox"/> 26-30 |
| <input type="checkbox"/> <1 | <input type="checkbox"/> 31-35 |
| <input type="checkbox"/> 1-5 | <input type="checkbox"/> 36-40 |
| <input type="checkbox"/> 6-10 | <input type="checkbox"/> 41-45 |
| <input type="checkbox"/> 11-15 | <input type="checkbox"/> 46-55 |
| <input type="checkbox"/> 16-20 | <input type="checkbox"/> 55 or more |
| <input type="checkbox"/> 21-25 | |

8. During the past 12 months, how often, on the average, have you done the following?

	Never	Once or Twice	3-6 Days	7-11 Days	Once a Month	2-3 Days per Month	1-2 Days per Week	3-4 Days per Week	5-6 Days per Week	About Every Day
Smoked Cigarettes										
Smoked Cigars										
Smoked a Pipe										
Chewed Tobacco										
Used Snuff										

9. During the past 12 months, how many times per day did you dip or chew, on the average?

- N/A 1 2 3 4 5 6 7 8 9+

10. During the last 12 months, how many cigars or pipe bowls per day did you smoke, on the average?

- N/A 1 2 3 4 5 6 7 8 9+

11. During the last 12 months, how many cigarettes per day did you smoke, on the average?

- | | |
|--------------------------------|-------------------------------------|
| <input type="checkbox"/> N/A | <input type="checkbox"/> 26-30 |
| <input type="checkbox"/> <1 | <input type="checkbox"/> 31-35 |
| <input type="checkbox"/> 1-5 | <input type="checkbox"/> 36-40 |
| <input type="checkbox"/> 6-10 | <input type="checkbox"/> 41-45 |
| <input type="checkbox"/> 11-15 | <input type="checkbox"/> 46-55 |
| <input type="checkbox"/> 16-20 | <input type="checkbox"/> 55 or more |
| <input type="checkbox"/> 21-25 | |

12. During the past 30 days, about how often, on the average, have you done the following?

	Never	Once or Twice	1-2 Days per Week	3-4 Days per Week	5-6 Days per Week	About Every Day
Smoked Cigarettes						
Smoked Cigars						
Smoked a Pipe						
Chewed Tobacco						
Used Snuff						

13. During the past 30 days, how many times per day did you dip or chew, on the average?

- N/A 1 2 3 4 5 6 7 8 9+

14. During the last 30 days, how many cigars or pipe bowls per day did you smoke, on the average?

N/A 1 2 3 4 5 6 7 8 9+

15. During the last 30 days, how many cigarettes per day did you smoke, on the average?

<input type="checkbox"/> N/A	<input type="checkbox"/> 26-30
<input type="checkbox"/> <1	<input type="checkbox"/> 31-35
<input type="checkbox"/> 1-5	<input type="checkbox"/> 36-40
<input type="checkbox"/> 6-10	<input type="checkbox"/> 41-45
<input type="checkbox"/> 11-15	<input type="checkbox"/> 46-55
<input type="checkbox"/> 16-20	<input type="checkbox"/> 55 or more
<input type="checkbox"/> 21-25	

16. Have you ever had a medical problem that was possibly related to tobacco use? Yes No

If so, please describe and give date of occurrence.

APPENDIX B
TOBACCO USE SURVEY SUMMARY

TOBACCO USE SURVEY

1. Years of Tobacco Use?

N/A	0-1	2-5	6-10	11-20
111	19	30	29	16

2. Age Tobacco Was First Used Regularly?

N/A	<12	12-14	15-17	>18	Total
109	11	20	27	37	207

3. Ever Smoked Cigarettes?

Never	Current	Quit	Total
145	14	35	194

4. Ever Chewed Tobacco?

Never	Current	Quit	Total
141	32	15	188

5. Ever Used Snuff?

Never	Current	Quit	Total
152	30	9	191

6. How Often Smoked Cigarettes (until 1 year ago)?

Never	1-2/ days	3-11/ days	1-3days/ month	1-6days/ week	Everyday	Total
155	9	1	5	4	14	188

7. How Often Chewed Tobacco (until 1 year ago)?

Never	1-2/ days	3-11/ days	1-3days/ month	1-6days/ week	Everyday	Total
135	11	3	6	16	17	188

8. How Often Used Snuff (until 1 year ago)?

Never	1-2/ days	3-11/ days	1-3days/ month	1-6days/ week	Everyday	Total
153	5	1	1	8	25	193

9. How Many Times Per Day Dipped or Chewed (until 1 year ago)?

Never	1-2	3-5	>5	Total
135	17	30	24	206

10. How Many Times Per Day Smoked Cigarettes (until 1 year ago)?

Never	1	2-10	1/2-1 pack	1 pack or more	Total
170	5	14	8	6	203

11. How Often Smoked Cigarettes (past 12 months)?

Never	1-2/ days	3-11/ days	1-3days/ month	1-6days/ week	Everyday	Total
166	4	3	5	4	9	191

12. How Often Chewed Tobacco (past 12 months)?

Never	1-2/ days	3-11/ days	1-3days/ month	1-6days/ week	Everyday	Total
147	8	5	4	14	14	192

13. How Often Used Snuff (past 12 months)?

Never	1-2/ days	3-11/ days	1-3days/ month	1-6days/ week	Everyday	Total
160	0	1	0	9	24	194

14. How Many Times Per Day Dipped or Chewed (past 12 months)?

Never	1-2	3-5	>5	Total
138	19	28	21	206

15. How Many Times Per Day Smoked Cigarettes (past 12 months)?

Never	1-2	3-5	>5	Total
182	10	4	5	201

16. How Often Smoked Cigarettes (past 30 days)?

Never	1-2/ days	1-2days/ week	3-6days/ week	Everyday	Total
169	5	5	0	9	188

17. How Often Chewed Tobacco (past 30 days)?

Never	1-2/ days	1-2days/ week	3-6days/ week	Everyday	Total
152	6	5	10	14	187

18. How Often Used Snuff (past 30 days)?

Never	1-2/ days	1-2days/ week	3-6days/ week	Everyday	Total
160	1	2	5	21	189

19. How Many Times Per Day Dipped or Chewed (past 30 days)?

Never	1-2	3-5	>5	Total
142	12	26	20	20

20. How Many Times Per Day Smoked Cigarettes (past 30 days)?

Never	1-2	3-5	>5	Total
183	8	4	4	199

21. Medical Problem Possibly Related to Tobacco Use?

Yes	No	Total
16	189	205

APPENDIX C

**TOBACCO USE COMPARISON DATA BETWEEN
SEALs AND GENERAL NAVY POPULATION**

1. Frequency Of Smokeless Tobacco Use in Last 12 Months

	Never	1-2 days	3-11 days	1-3 days/ month	1-6 days/ month	Everyday	Mean
SEALs	66	2	3	2	10	18	3-6 days
Navy	83	4	2	2	2	6	1-2 days

2. Number Of Times Dipped or Chewed Per Day Mean

	1	1-2	3-11	>7	Mean
SEALs	12	32	34	22	5 times per day
Navy	26	30	27	18	4 times per day

3. Frequency of Cigar/Pipe Use in Last 12 Months

	Never	1-2 days	3-11 days	1-3 days/ month	1-6 days/ week	Everyday	Mean
SEALs	95	3	1	1	2	0	Never
Navy	82	8	4	2	1	3	1-2 days

4. Number of Cigars or Bowls Per Day Mean

	1	2-3	4-5	>6	Mean
SEALs	86	14	0	0	1 cigar or bowl
Navy	61	24	5	10	2 cigars or bowls

5. Current Cigarette Smoker?

	No	Yes
SEALs	93	7
Navy	61	39

6. Number of Cigarettes Per Day (last 30 days) Mean

	0	<1	1-10	11-20	21-30	>30	Mean
SEALs	92	2	2	1	1	0	7 cigarettes
Navy	56	3	10	17	9	7	20 cigarettes

7. Years of Tobacco Use

	Mean	SD
SEALs	7.4	7.6
Navy	9.4	7.5

8. Age First Used Regularly (% users) Mean

	<12	12-14	15-17	>18	Mean
SEALs	11	22	28	39	15-17 years old
Navy	7	19	35	40	15-17 years old

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