The association between hospital admission and substance use among trauma patients

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Abstract

Background: Use of alcohol and other substances is prevalent in trauma patients admitted to hospital, but little is known about the consequences substance use has on type of injury and hospital course among drug and alcohol positive trauma patients.

Aims: To investigate the association type of injury and substance use had on the patient's risk of hospital admission. Further, if there was any relationship between type of substance use and type of injury.

Methods: This prospective cross sectional study includes all trauma patients admitted to Ullevaal emergency department in Oslo, Norway in 2008. The patients were classified according to the International Classification of Diseases system (ICD-10) and divided in the following groups: 1.Head, 2.Neck/Thorax/Abdomen and 3.Pelvis/Extremities. Furthermore the groups were distributed on the patients' variables: gender, age, treatment level, substance use and blood alcohol level (BAC).

Results: The study includes 998 trauma patients. Of these 39,3% screened positive for substance use when admitted. Hazardous use (alcohol level = >1,0 ‰, positive screening for illicit drug use or combination use) occurred in 23,9%. Trauma patients with head injury had a higher prevalence of alcohol use, 29,1%. Medicine use (mostly benzodiazepines) was more frequent in injury to pelvis/extremities, 17,3%. Multivariate analysis revealed a significant association between head injury, hazardous drug or alcohol use, and not being admitted to hospital for more than 24 hours (multivariate OR: 0,61, 95% CI: 0,41-0,93, p = 0,02). Patients with injuries to neck/thorax/abdomen and hazardous drug or alcohol use, had a higher risk of admission (multivariate OR: 5,22, 95% CI: 1,47-18,76, p = 0,01). Injuries in pelvis/extremities were more common among women who had used medicines (mostly benzodiazepines).

Conclusion: 39,3 % of all patients admitted with injury screened positive for substance use, and 23,9 % screened positive for hazardous use. Of those who screened positive for hazardous use, patients with head injury had a significantly lower risk of being admitted to hospital for more than 24 hours, whereas patients with injuries to the neck/thorax/abdomen had a higher risk.

Patients with injuries to pelvis/extremities were more often older women who had used medicine, mostly benzodiazepines.

Introduction

Worldwide, there are approximately 5.2 million deaths from injuries every year, and non-fatal injuries account for about one-tenth of the global burden of disease (World Health Organization art 1). In 2013, alcohol and drug use was the main risk factor for death in developed countries in the age group 5-14 years and 15-49 years for both genders (Health data). The relationship between substance use and traumatic injuries has been recognized for long, and harmful use of alcohol is one of the main risk factors to ill health. Alcohol alone is responsible for about 2.3 million premature deaths worldwide each year (World Health Organization art 2). Alongside alcohol, drug abuse is also an important factor affecting the mortality by injury. Every day people die as a result of drug overdoses, and in 2010 drug overdose was the leading cause of injury death in the United States (World Health Organization art 1).

Several studies have addressed the issue of drug and alcohol positive patients and injury (Kuendig, Hasselberg, Laflamme, Daepfen, & Gmel, 2008). Patients who arrive in Emergency Departments (ED) present with high prevalence of drug and alcohol consumption (Vitale & van de Mheen, 2006; World Health Organization art 2). Patients with low and moderate levels of alcohol consumption have a higher risk for all types of injury (Kuendig et al., 2008), and it appears to be a correlation between patients who screen positive for drug and alcohol use and injuries to the head and the abdominal area (Hooper, 2007; Kuendig et al., 2008; Rubinsky et al., 2012). Initial assessment of these patients may also be more difficult. One study also shows that patients with positive alcohol screening present with a lower initial Glasgow Coma Scale (GCS) (Hooper, 2007).

Studies have assessed if there are any differences in treatment needs for patients screening positive for any type of substance use when admitted. The patients who have ingested both alcohol and drugs have a higher risk of in hospital complications overall and pneumonia in particular (Rootman, Mustard, Kalia, & Ahmed, 2007), and increased risk of intensive care unit (ICU) admission (Wiener et al., 2010). Those who have abused alcohol or drugs exclusively appear to have a significantly higher complication rate, length of stay (LOS), higher hospitalization cost than drug and alcohol negative patients (Cowperthwaite & Burnett, 2011; Hsieh et al., 2013). The clinical outcome, however, did not differ between patients who screened

positive for alcohol or drugs, and patients who screened negative (Cowperthwaite & Burnett, 2011). One study has concluded that alcohol use actually has the opposite effect; shorter LOS, lower injury severity score and lower in-hospital mortality. It has been suggested that this could be because trauma patients who present with acute alcohol intoxication have fewer medical comorbidities, and are taking fewer medications than patients who abstain from alcohol. Further, that intoxication is directly influencing routine trauma measurements and decreased ICU admission (Lank & Crandall, 2014).

In order to investigate the admission rate, groups with comparable injuries were created as admission rates may vary by injury type. The groups were: head, neck/thorax/abdomen and pelvis/extremities. Whole blood analysis was used to measure concentrations of alcohol, illicit substances, medicine use and combinations of these. It was assumed that most people with risky substance use to a greater extent had poorer health and therefore increased risk of hospitalization. In the current study, we wanted to investigate the prevalence of substance use among trauma patients according to age, gender, type of injury, and level of treatment (observation <24 hours, admission to General Ward or admission to Intensive Care Unit).

Methods

Setting

This was a prospective cross-sectional study of all trauma patients admitted to the Emergency Department (ED), Oslo University Hospital Ullevaal in 2008. Ullevaal hospital is one of Scandinavia's largest hospitals, and is located in Oslo, Norway. The hospital carries out more than 1.2 million patient treatments every year. The hospital is a level 1 trauma centre and is primarily an emergency hospital for east and southern Norway, covering a population of approximately 2.5 million citizens.

Participants

Patients admitted to the ED with trauma injuries to the head, neck/thorax/abdomen or pelvis/extremities, were included in the study if they were: over 18 years of age, with intact

cognition, and able to understand Norwegian and with the ability to give an informed consent. If the patient could not give informed consent, and his or her next of kin was at the hospital and available for consent, they were asked if the patients could participate. Patients admitted 48h after injury were also excluded from the study.

Patients who were discharged without an ICD-10 diagnosis were also excluded. This was a subsample of a study including all patients admitted with injuries. The refusal rate for the whole study was 7% and 24% were not invited to participate for other reasons, described elsewhere (see (Bogstrand et al., 2011 for further details)

Variables

Type of injury was classified based on the International Classification of disease 10th edition (ICD-10): Head injury: S0x, Neck/Thorax/ Abdomen: S1x, S3x, and S2x, Pelvis/Extremities: S7x, S4x, S5x and S8x. Substance use was classified in four groups: Negative, Alcohol, Illicit drug use or combinations, and Medicine. “Negative” includes a concentration of alcohol below 0,1g/kg and/or no detectable illicit substance and/or medicine. “Illicit drug use or combinations” include gammahydroksybutyrate (GHB), cocaine, benzoylecgonine, ecstasy (3,4-methylenedioxy-N-methyamphetamine), methamphetamine, amphetamine, cannabis (tetrahydrocannabinol), heroin (metabolite 6-monoacetylmorphine) and phenazepam. “Medicine” includes carbamazepine, zolpidem, zopiclone, nitrazepam, diazepam, oxazepam, alprazolam, clonazepam, flunitrazepam, buprenorphine, dextropropoxyphene, methadone, morphine, ethyl morphine, oxycodone, carisoprodole, meprobamate, codeine, and phenobarbital. These medicines were chosen because they are addictive and potentially misused.

Alcohol concentrations were divided in “Negative” = 0 ‰, “Low” = 0, 1-1,0 ‰, “Moderate” = 1,01-1,7 ‰ and “High” = >1,7 ‰. In table 3, the variables for substance use were combined to “hazardous drug or alcohol use”. This variable included patients with an alcohol level = >1,0 ‰, positive screening for illicit drug use or combination use. Combination use means consumption of substances relating to more than one of the three substance groups: alcohol, illicit drug and medicine. Age was divided into three groups: 18-35 years, 36-64, and >65. Treatment levels were divided into: “Observation”; admitted and discharged before 24h after arriving at the ED, “Admission Clinical Ward (CW)”; admitted only to CW more than 24 hours after arriving at the

ED. “Admission Intensive Care Unit (ICU)”); admitted only to ICU or to both CW and ICU for more than 24 hours after arriving at the ED.

Data collection and data source

Blood samples and questionnaires were collected from all patients who had consented to study participation and were admitted to the Emergency Department for treatment of injuries. All patients included were screened for substance use by analysing blood samples that had been taken shortly after admission. The limit of detection for each substance corresponding to 3-5 times the signal to noise ratio was used as cut-off value to indicate the presence of the drug. The blood samples were first screened for amphetamines, cannabis, cocaine, metabolites and opiates by an immunological method (Gjerde, Christophersen, Skuterud, Klemetsen, & Morland, 1990). Screening for other drugs was carried out using high-performance liquid chromatography with mass spectroscopy detection (LC-MS) (A. S. Christophersen, Gulliksen, M., Hasvold, I., Johansen, U., Karinen, R., Ripel, A., 2001). The blood samples were analysed for all impairing drugs on the Norwegian marked which have been shown to be linked to increased accident risk (Morland, 2000). Medical records and questionnaires were screened for injury type in form of ICD-10 codes. All the extracted data were electronically transferred to the project database.

Ethics

All patients who were invited to participate were informed about the project verbally as well as in writing and were asked to give written informed consent. Patients were also informed that they could withdraw from the project at any time during data collection. The Data Inspectorate and the Regional Ethics Committee in Norway approved the study.

Statistical methods

Categorical data were computed using bivariate cross tables, and statistical significance was calculated with Pearson’s chi-square or Fishers exact test when expected count in a group was less than five. Adjusted odds ratios were computed using multivariate logistic regression. All analyses were made in PASW 20 (SPSS.inc, Chicago IL). The level of statistical significance was $\leq 0,05$.

Results

Participants

The study population consisted of 998 patients, 59,4% men and 40,6% women (table 1). Head and neck/thorax/abdomen injuries were more common among men than women (70,4% and 69,4%), while injuries to pelvis/extremities were more common among women, 57,1%. For patients with head injuries, 46,8% were 18-35 years old, whereas 50,5% of those with injuries to pelvis/extremities were ≥ 65 years old. Of all the patients who arrived at the ED 29,5% were not admitted. The admission rates differed by diagnosis, 50,8% of patients with head injury were not admitted for more than 24 hours, while the proportion was 10,7 % for those who sustained injury to pelvis/extremities. Of all the patients admitted to the CW, pelvis/extremities accounted for the largest group, 59,7%. Neck/Thorax/Abdomen accounted for the largest group of all the patients admitted to the ICU, 55,2%.

Drug and alcohol prevalence

In the study, 39,3% of all the patients who arrived at the ED screened positive for drug and/or alcohol, 25,7 % for alcohol, 10,5 % for medicine and 11,0 % for illicit/combo. For head injuries, alcohol had the highest prevalence, 29,1 %. Among these, 32,2 % had a moderate or high BAC, compared to 5,4 % in the pelvis/extremities group. For patients with pelvis/extremities injuries, medicine use was most common, 17,3%. 23,9% of the patients admitted had a hazardous drug or alcohol use (BAC = $>1\%$, positive screening for illicit drug use or combination use), and the proportion of this use was largest among those with head injury, 39,5% (table 1)

The prevalence of substance use was higher among those who were admitted for less than 24 hours, 45,9%, compared with those who were admitted for more than 24 hours, 36,5% (table 2).

Of all the patients with injury to neck/thorax/abdomen, 79,8% were admitted to the ED for more than 24 hours. For those who screened positive for any type of substance use and with injury to neck/thorax/abdomen 92,2% were admitted, compared with those who screened negative, 73,1%.

There was no significant association between those who screened positive for alcohol, illicit/combo or medicine use and hospital admission when injuring head or pelvis/extremities (table 2). For those with hazardous drug or alcohol use (BAC = >1‰, positive screening for illicit drug use or combination use) multivariate analyses revealed a significant association (table 3).

Multivariate analyses revealed that there was a significant association between having a head injury in combination with hazardous drug or alcohol use, and not being admitted to hospital (multivariate OR: 0,61, 95% CI: 0,41-0,93, $p = 0,020$) (table 3). In contrast to this, patients with injuries to neck/thorax/abdomen combined with hazardous drug or alcohol use had a higher risk of being admitted to the hospital (multivariate OR: 5,22, 95% CI: 1,46-18,75, $p = 0,011$) (table 3). For neck/thorax/abdomen injuries, patients with an age >65 revealed a higher probability of hospital admission (multivariate OR: 13,99, 95% CI: 1,71-114,69, $p = 0,014$) (table 3). Among patients with pelvis/extremities injuries there was no association between hazardous drug or alcohol use and hospital admission, however, males showed a lower risk of admission (multivariate OR: 0,32, 95% CI: 0,51-0,66, $p = 0,002$) (table 3).

Discussion

In this study, almost 40% of all the patients arriving to the Emergency Departments (ED) screened positive for any type of substance use. 23,9% of all the patients admitted had a hazardous drug or alcohol use. This study showed that there was a significant association between having a head injury in combination with hazardous drug or alcohol use, and not being admitted to the hospital for more than 24 hours. In contrast, patients with injuries to neck/thorax/abdomen combined with hazardous drug or alcohol use had a higher risk of being admitted to the hospital.

The high prevalence of patients screening positive for any substance use in our study is

supported by previous studies (Plurad et al., 2010; World Health Organization art 2). Our data also revealed that the prevalence of substance use was higher among those who were admitted for less than 24 hours, 45,9%, compared with those who were admitted for more than 24 hours, 36,5%. Studies report that patients with positive alcohol screening present with a lower initial Glasgow Coma Scale (GCS) (Hooper, 2007) and that the similarities in the clinical presentation of patients with acute brain injury and those who are intoxicated appear to influence pre hospital care (Gurney et al., 1992). In the initial stage of hospital admission, it may be difficult to determine if head injury or substance use is the main factor for the low GCS. In our study, patients with head injury and hazardous drug or alcohol use had a lower risk of hospital admission. An explanation could be that the low GCS is mostly due to substance use and not head injury, and the patient is no longer in need for admission when the toxic concentrations have decreased.

Studies present a correlation between patients who screen positive for drug and alcohol use and injuries to the head and the abdominal area (Hooper, 2007; Kuendig et al., 2008; Rubinsky et al., 2012). Injury to the abdominal area often results in more profound bleeding and altered hemostasis among intoxicated patients. This may pose a greater risk for complications (Hooper, 2007). This could be an explanation for our result: greater risk for admission when injury to the abdominal area and hazardous drug or alcohol use.

Studies show that trauma patients who test positive for both alcohol and drug use are found to be significantly more likely to experience complications than the non-intoxicated (Rootman et al., 2007). Alcohol impairs compensatory responses to injury that are critical to survival, such as: Increased pulmonary vascular resistance and impaired cardiovascular response to acute blood loss, resulting in increased likelihood of serious complications (Blomqvist et al., 1987; McDonough, Giaimo, Miller, & Gentilello, 2002; Moore, 2005).

One study concludes that drug and alcohol use is common among patients with orthopaedic injuries, and that these patients have more severe injuries (i.e. open fractures) and require longer hospitalization (Levy, Hebert, Munn, & Barrack, 1996). Even though our study reported an OR of 2,5, it was no statistically significant correlation between being admitted and having injury to

extremities, when screening positive for hazardous alcohol and drug use. The reason might be that the study population is too small when separated into sub groups

Limitation and strengths

This study has several limitations. One limitation is that comorbid conditions were not measured. This could have had an impact on the patient's risk of hospital admission, comparing the correlation between age, type of injury and substance use. The study uses the blood concentration of drugs and alcohol to assess high-risk drug and alcohol use. This is, however, just an indication of such use. It would have strengthened the study if we had self-reported data from the patient or other sources of information about the patients' level of substance use. This, might have made it possible to differentiate between high- and low-risk drug and alcohol use. The study is performed on a large number of patients, but when patients are divided into many sub-groups, it is difficult to show a significant correlation between admission, injury to pelvis/extremities and hazardous drug or alcohol use. This is a limitation to the study and studies on larger populations are therefore necessary.

It was a strength that the study site was performed at a hospital, which is both a local hospital and trauma centre. This gives a more comprehensive overview of all injury types, considering that the hospital treats both major traumas and less severe injuries. Further strength in this study was that the data were collected over a 12 months period, avoiding seasonal influence on the type of injury.

An accredited laboratory in forensic toxicology carried out the analyses of the blood samples and this supports the high quality of analytical results (A. S. Christophersen & Morland, 1997).

There was no alternative center for emergency treatment, which could bias the patient population.

Implications

The study reveals a lower risk of hospital admission when having a head injury in combination with hazardous drug or alcohol use. Patients who are under the influence of any type of

substance use may be misinterpreted with having a head injury and therefore brought to the hospital. Many patients with trauma to the head are also brought to the hospital for an examination with a Computed Tomography (CT). The examination may then conclude that the injury was not as severe as first expected and the patients are discharged when they have sobered up. This could have had an impact on the result in our study, that 50,8% of the patients with head injury were not admitted for more than 24 hours. Nevertheless, it is important to screen patients with possible head injury, since severe head injury often leads to fatal consequences when undiagnosed and untreated.

When admitted to the ED, the main focus is the patient's clinical status and treatment of the injuries. Nearly half of the patients admitted with head injury, screened positive for any substance use. With this data in mind, it could be indicated to invest more time in preventive work against substance use during treatment of the injury to minimize re-admissions in the future (Havard, Shakeshaft, & Sanson-Fisher, 2008). Preventive work against substance use is also important in the society in general, since patients with substance use overall have a greater risk of injuries.

Studies show inconsistent results on how substance use has an impact on the patient's LOS and risk for admission (Cowperthwaite & Burnett, 2011; Lank & Crandall, 2014; Wiener et al., 2010). This study shows that risk for admission, when influenced by alcohol and drugs depend on the injury type. The different admission rates for different injuries must be taken into consideration in future studies. Further research should investigate hospital course, length of stay and readmission rate, to give a better understanding of the patients' outcome and the economic aspect of trauma patients with substance use.

The data in this study shows a tendency towards a relationship between injuries to pelvis/extremities among elderly females with medicine use. Use of sedative medicine is common in this age group, and the patients General Practitioner (GP) primarily do prescription of such medicine. Therefore, it is important that the GPs have this relationship in mind when prescribing sedative medicines, especially among patients who are at greater risk of falling. More research on this topic may prevent such injuries.

Conclusions

In summary, almost 40 % of patients admitted with injury screened positive for any substance use, and 23,9 % with a hazardous drug or alcohol use. This highlights the consistency of the risk associated with substance use and injury, and the importance of preventive work against substance use. The risk of being admitted for more than 24 hours was higher among patients with hazardous drug or alcohol use and with injuries to neck/thorax/abdomen, contrary to patients with head injuries. Patients with injuries to pelvis/extremities were more often older women who had used medicine, mostly benzodiazepines.

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Table 1 Associations between injury, gender, age, treatment level, intoxication and BAC

	Head	Neck/Thorax/Pelvis/Extremities	Abdomen	Total
Gender				
Male	298	127	168	593
	70,4%	69,4%	42,9 %	59,4%
Female	125	56	224	405
	29,6 %	30,6 %	57,1%	40,6%
Total	423	183	392	998
	100,0%	100,0%	100,0%	100,0%
P-value < = 0,000				
Age				
18-35	198	72	62	332
	46,8%	39,3%	15,8%	33,3%
36-64	155	82	132	369
	36,6%	44,8%	33,7 %	37,0%
>=65	70	29	198	297
	16,5%	15,8%	50,5 %	29,8%
Total	423	183	392	998
	100,0%	100,0%	100,0%	100,0%
P-value < = 0,000				
Treatment level				
Observation	215	37	42	294
	50,8%	20,2%	10,7%	29,5%
Admitted Clinical Ward	120	45	234	399
	28,4%	24,6%	59,7%	40,0%
Admitted Intensive Care Unit	88	101	392	305
	20,8%	55,2%	29,6%	30,1%
Total	423	183	392	998
	100,0%	100,0%	100,0%	100,0%
P-value < = 0,000				

Toxic agents detected				
Negative	205	119	282	606
	48,5%	65,0%	71,9%	60,7%
Alcohol	123	35	19	177
	29,1%	19,1%	4,8%	17,7%
Illicit/Combo	72	15	23	110
	17,0%	8,2%	5,9%	11,0%
Medicine	23	14	68	105
	5,4%	7,7%	17,3%	10,5%
Total	423	183	392	998
	100,0%	100,0%	100,0%	100,0%
P-value <= 0,000				
BAC				
Negative	244	142	356	742
	57,7%	77,6%	90,8 %	74,3%
Low 0,1-1,0	43	14	15	72
	10,2%	7,7%	3,8 %	7,2%
Moderate 1,01-1,7	62	14	9	85
	14,7 %	7,7%	2,3 %	8,5%
High >1,7	74	13	12	99
	17,5%	7,1%	3,1 %	9,9%
Total	423	183	392	998
	100,0%	100,0%	100,0%	100,0%
P-value <= 0,000				
Hazardous drug or alcohol use				
Yes	256	145	358	759
	60,5%	79,2%	91,3%	76,1%
No	167	38	34	239
	39,5%	20,8%	8,7%	23,9%
Total	423	183	392	998
	100,0%	100,0%	100,0%	100,0%
P-value <= 0,000				
BAC = Blood Alcohol Concentration				

Table 2 Associations between substance use, injury and admission

		Substance					
Diagnosis	Admission	Negative	BAC 0.1-1	BAC>1	Illicit/ combo	Medicine	Total
Head	No	93 45,4%	14 50,0%	54 56,6%	40 55,6%	14 60,9%	215 50,8%
	Yes	112 54,6%	14 50,0%	41 43,2%	32 44,4%	9 39,1%	208 49,2%
	Total	205 100,0%	28 100,0%	95 100,0%	72 100,0%	23 100,0%	423 100%
P-value	0,249						
Neck, thorax, abdomen	No	32 26,9%	0 0,0%	0 0,0%	3 20,0%	2 14,3%	37 20,2%
	Yes	87 73,1%	12 100,0%	23 100,0%	12 80,0%	12 85,7%	146 79,8%
	Total	119 100,0%	12 100,0%	23 100,0%	15 100,0%	14 100,0%	183 100,0%
P-value	0,014						
Pelvis, extremities	No	34 12,1%	0 0,0%	0 0,0%	2 8,7%	6 8,8%	42 10,7%
	Yes	248 87,9%	8 100,0%	11 100,0%	21 91,3%	62 91,2%	350 89,3%
	Total	282 100,0%	8 100,0%	11 100,0%	23 100,0%	68 100,0%	392 100,0%
P-value	0,531						
Total	No	159 26,2	14 29,2%	54 41,9%	45 40,9%	22 21,0%	294 29,5%
	Yes	447 73,8%	34 70,8%	75 58,1%	65 59,1%	83 79,0%	704 70,5%
	Total	606 100,0%	48 100,0%	129 100,0%	110 100,0%	105 100,0%	998 100,0%
P-value	<=0,000						

Table 3 Associations between admission to hospital and high BAC, age and gender

Head Injuries	Univariate				Multivariate			
	OR	95% CI		P-value	OR	95% CI		P-value
Hazardous drug or alcohol use	0,70	0,47	1,03	0,070	0,61	0,41	0,93	0,020
Age 18-35 (ref.)								
Age 36-64	1,15	0,75	1,75	0,525	1,14	0,74	1,75	0,558
Age > 65	0,68	0,39	1,18	0,172	0,64	0,36	1,15	0,137
Male	1,34	0,88	2,04	0,169	1,37	0,88	2,13	0,165
Injuries to Neck, thorax, abdomen	Univariate				Multivariate			
	OR	95% CI		P-value	OR	95% CI		P-value
Hazardous drug or alcohol use	3,57	1,03	12,35	0,044	5,22	1,46	18,75	0,011
Age 18-35 (ref.)								
Age 36-64	1,19	0,56	2,50	0,656	1,53	0,70	3,34	0,291
Age > 65	9,33	1,18	73,58	0,034	13,99	1,71	114,69	0,014
Male	0,81	0,36	1,80	0,598	0,97	0,40	2,32	0,942
Injuries to Pelvis, extremities	Univariate				Multivariate			
	OR	95% CI		P-value	OR	95% CI		P-value
Hazardous drug or alcohol use	2,01	0,47	8,72	0,350	2,53	0,57	11,31	0,225
Age 18-35 (ref.)								0,483
Age 36-64	0,56	0,20	1,57	0,268	0,54	0,19	1,54	0,249
Age > 65	0,83	0,30	2,31	0,717	0,54	0,18	1,62	0,270
Male	0,38	0,19	0,73	0,004	0,32	0,15	0,66	0,002