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ORIGINAL ARTICLE

Risk factors for persistent frequent use of the primary health care services among frequent attenders: A Bayesian approach

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Abstract

Objectives. The aim of this study was to examine risk factors that predict persistent healthcare frequent attendance among a frequent attender (FA) population. *Design.* Prospective cohort study without intervention. *Setting.* Primary healthcare centre in Tampere, Finland. *Subjects*. A total of 85 primary healthcare working-age patients participated in the study. All participants were FAs in the first study year. *Main outcome measures.* We identified two groups of patients: temporary FAs and persistent FAs. A patient was considered as a persistent FA if he or she visited the health centre at least eight times a year for at least three out of four follow-up years. Some 59 different variables were examined as potential risk factors for persistent FA. P-course, a web-based Naïve Bayesian classification tool, was used for the modelling of the data. *Results*. In our model, the most influential predictive risk factors for persistent frequent attendance in an FA population were female gender, body mass index above 30, former frequent attendance, fear of death, alcohol abstinence, low patient satisfaction, and irritable bowel syndrome. New observations were high body mass index, alcohol abstinence, irritable bowel syndrome, low patient satisfaction, and fear of death. *Conclusions.* In FA analyses, distinction between temporary and persistent frequent attendance should be made. Our Bayesian model could be used for identifying persistent FAs in uncertain situations. The model can quite easily be further developed as a practical decision support tool for general practitioners. However, before its use in practice, the external validity of the model will need to be defined.

Key Words: *Data mining, decision-making, family practice, follow-up studies, frequent attender, health services research/utilization, prognosis/methods*

Frequent attenders (FAs) generate a large proportion of GPs' clinical workload [1]. Very frequent attenders account also for a great proportion of GPs' referrals and prescriptions [2]. Two systematic reviews show that FAs have high rates of physical disease, emotional distress, psychiatric illness and social difficulties [3,4]. A systematic review of interventions on FAs found all the interventions in reducing healthcare utilization by FAs to be ineffective [5]. The interventions analysed were made for the patients who were FAs for up to two consecutive years [5]. Some 7–33% of FAs persist as FAs in follow-ups [6–13]. Compared with temporary FAs, persistent FAs consume even more healthcare services and are not diagnosed only with somatic diseases but in particular more social problems, psychiatric problems, and medically unexplained physical symptoms [14].

It is important to identify early potential persistent FAs in primary healthcare in order to rationalize their inappropriate care and to assess their suitability for GPs' patient lists. Predicting the long-term use of the primary care services among FAs has previously been uncommon. However, healthcare administrators and practitioners need tools for assessing the risk of persistent frequent attendance.

Material and methods

Subjects

In Finland, Tampere Health Centre offers public primary healthcare services for a population of 200 000. A random sample of 200 FAs meeting the inclusion criteria (age between 18 and 64 years and eight GP

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Frequent attenders generate a large proportion of GPs' clinical workload.

- When predicting persistent frequent attendance, distinction between temporary and persistent frequent attendance should be drawn.
- Persistent frequent attendance in contrast to temporary frequent attendance was related to high body mass index, alcohol abstinence, irritable bowel syndrome, low patient satisfaction, and fear of death.
- Bayesian prediction tools are useful for screening risk factors for frequent attendance.

visits to the health centre in 2002; visits not explained by same repeated treatment or operation) from the primary healthcare patients of Tampere Health Centre was drawn from the patient database. These FAs belonged to the group of 2% of patients with most frequent contacts in their age group. An invitation letter to the study was sent to the sampled patients.

A total of 85 patients gave written consent and were accepted in the study. The average age of the study patients was 52.7 years (95% CI 50.3–55.2). The average age of the non-participating patients (n = 115) of the random sample was 45.1 years (CI 42.7–47.6); 69.4% (CI 59%–78%) of the study patients were females. Some 70.4% (CI 62%–78%) of the non-participating patients among the random sample were females.

The assessment was comprehensive. At the beginning of the study, patients completed nine different questionnaires and the basic information on the patients was requested in a particular form. Beck's Depression Inventory (BDI) [15], Sense of Coherence (SOC-13) [16], generic 15D quality of life instrument [17], Toronto Alexithymia Scale (TAS-20) [18], Symptom Checklist (SCL) for the somatization part [19], Whitely Index [20], and the measurements for patient satisfaction [21], fear of death,[1] and alcohol consumption [22] were used. The use of healthcare services was followed up for four years. The follow-up was complete. Health centre visits by all 85 study patients were recorded during the follow-up. No intervention was undertaken during the study.

Methods

The outcome of the modelling was persistent frequent attendance (a patient was considered as a persistent FA if he or she visited the health centre at least eight times in a year in three out of four follow-up years). We studied in total 59 different variables as potential risk factors for persistent frequent attendance among the FA population. In addition to the above questionnaires these variables included demographic variables, diagnoses, and medication.

P-course, a web-based Naïve Bayesian (NB) prediction tool, was used in the modelling. NB methods have equalled or outperformed novel logistic regression especially in small data sets in terms of prediction accuracy [23,24], variable selection, and multiple performance measures [24]. They can perform well with incomplete or complex data [24,25] typical of small data sets. Modelling of the data was undertaken without informative a priori information.

Before modelling the potential predictive variables were pre-screened by cross-tabulating them with the outcome. Variables with a corresponding p-value of below 0.3 in bivariable analysis were used as potential risk factors in the modelling. Large p-values may be feasible in NB, because in small datasets the variable may be non-significant. However, due to complex relationships, the effect may be important for prediction in a multivariable model.

The relation between the outcome and risk factor was assessed with the posterior odds (POs),[2] which are not directly dependent on data size and give an idea of a risk factor's strength [24]. The estimated credibility intervals (CrI)[3] for POs directly indicate the limits for the probability of finding the mean PO within given limits.

A total of 22 variables which had an association with the outcome were selected as potential risk factors for the modelling of the data. To avoid overfitting of the model, we took several random samples of the data and chose those risk factors that appeared in at least two different models for the final modelling.

A total of 12 different variables were selected as potential risk factors for the final modelling of the data. Instead of maximal predictive accuracy we also looked for plausible *robust* explanations for persistent frequent attendance.

Results

Study patients were a selected group of patients regarding age, chronic diseases, and education. Some 71% of the all study patients had at least four chronic diseases, 67% were aged between 50 and 64 and 84% had the highest educational level in vocational school. A total of 31% of study patients were classified as persistent FAs.

In our model, the seven most influential predictive risk factors for persistent frequent attendance among FAs were female gender, body mass index (BMI)[4] above 30, former frequent attendance, fear

Table I. Characteristics of the demographic factors of the study patients.

	Temporary FAs[1]		Persistent FAs[1]		
	n	%[2]	n	%[2]	p-value[3]
Total	59		26		
Female gender	38	64	21	81	0.131
Age (years)					
20–49	21	36	7	27	0.433
50–64	38	64	19	73	0.433
Body Mass Index (BMI)					
⩾30	9	15	11	42	<0.010**
Alcohol consumption					
Abstinence	10	17	11	44	<0.010**
Smoking					
Current smoker	21	36	5	19	0.131
Education					
No vocational education	16	27	14	54	<0.050*
Marital status					na
Single	6	10	1	4	
Married or live together	34	58	12	48	
Widowed	3	5	4	16	
Separated/divorced	16	27	8	32	
Children					
⩾ 3	16	27	2	8	<0.050*

Notes: [1]Frequent attenders.
[2]Percentage of the class in this FA group.
[3]Bivariate analyses, categorical variables: Pearson's chi-squared test. [3] Year 2002, first year of the follow-up.
*Significant at 0.050 level.
**Significant at 0.010 level.

of death, alcohol abstinence, low patient satisfaction, and irritable bowel syndrome. These risk factors found in this model were mainly new or had been only marginally discussed previously. New observations were the association of high BMI, alcohol abstinence, irritable bowel syndrome, low patient satisfaction, and fear of death with persistent frequent attendance.

The predictive accuracy of our Bayesian model, measured as a proportion of correctly classified patients, was 83.5%. Compared with the largest class (i.e. default or educated guess), the model led to 20% higher accuracy which means more predictive performance (i.e. every fifth patient is predicted more correctly with the model). The final Bayesian model was able to discriminate all the patients in spite of incomplete data. In the earlier phases of the modelling process the approach was used successfully for the screening of potential risk factors for persistent frequent attendance.

The specificity of our Bayesian model was 95%, but its sensitivity was only 58%. Thus this model is appropriate to confirm the condition. Due to the small size of the training set (i.e. the set used for modelling), we used only partitioning of the training set in the accuracy assessments instead of an independent test set. We tested our model with four different so-called pseudo subsets (25 patients in each) formed out of the training material. The generalization of these results outside the training set is limited due to the modest size of the training and test material.

Discussion

This study helps in identifying the risk factors for persistent frequent attendance among a FA population. There are no previous studies undertaken in a similar fashion. Most of the earlier studies regarding FAs have had a cross-sectional design. However, the most resource-consuming FAs seem to persist as FAs in long-term follow-up.

Table II. Numbers of illnesses, medicines, and visits by the study patients.

	Temporary FAs median (mean)	Persistent FAs median (mean)	p-value[1]
Chronic illnesses	4 (4.4)	5 (5.1)	0.144
Regular medicines	2 (2.6)	3.5 (3.9)	0.083
Health centre visits[2]	10 (10.3)	12 (14.2)	<0.010**

Notes: [1]Mann–Whitney U-test.
[2]Year 2002, first year of the follow-up.
**Significant at 0.010 level.

Table III. Characteristics of the psychosocial factors of the study patients.

	Temporary FAs[1]		Persistent FAs[1]		
	n	%[2]	n	%[2]	p-value[3]
Psychiatric illnesses					
At least one diagnosis previously	26	44	14	54	0.405
Depression[4]					
At least mild[5]	19	32	11	44	0.302
Patient satisfaction[6]					
Low[7]	8	14	11	44	<0.010**
15D[8]					
Low[9]	17	29	11	42	0.223
Social support network[10]					
Thin[11]	14	25	8	32	0.513

Notes: [1]Frequent attenders.
[2]Percentage of the class in this FA group.
[3]Bivariate analyses, categorical variables: Pearson's chi-squared test.
[4]Beck Depression Inventory.
[5]Cut-off point ≥10.
[6]This item was measured by 13 item (grades from 4 to 10) scale.
[7]Cut–off point of the classified mean of all 13 questions <7.
[8]Generic, comprehensive (15-dimensional), self-administered instrument for measuring health-related quality of life among adults. 15D score on a 0–1 scale. Average in this study population is 0.84. Age- and sex-matched average with this study population in the general (Finnish) population is 0.92.
[9]Cut-off point here for the low health-related quality of life is <0.8, which is the lowest third of the responses.
[10]Brief Social Support Questionnaire.
[11]Less than two persons who provide with help or support.

Based on the valid data, we profiled the risk factors for persistent frequent attendance among an FA population. This has the potential to identify these patients and to help to focus interventions on these patients. The strengths of the study were prospective design, a four-year follow up, and the lack of dropouts during the follow-up.

In our model new or only marginally discussed risk factors were alcohol abstinence, low patient satisfaction, irritable bowel syndrome, body mass index above 30, and fear of death. The reasons for these new observations were probably the design used in this study and the great number of potential risk factors analysed in the data-mining process. The Bayesian modelling method can also find even non-linear interrelations between variables in small data sets. The benefit of this study in practice is that the clinician is aware of these less known signs of persistent frequent attendance resulting in high use of healthcare resources. These findings can have important implications for future studies and in the development of appropriate interventions for persistent frequent attenders.

All the new risk factors for persistent frequent attendance were logical. First, the association of alcohol abstinence could be explained by the patient's increased sensitivity to symptoms as a result of alcohol drinking, or as part of the patient's conviction, which at the same time may predispose to anxiety and frequent attendance. Second, the association of irritable bowel syndrome could also be explained by the patient's increased sensitivity to symptoms or by the nature of these symptoms without organic explanation, or as a consequence of a stimulated autonomic nervous system connected to stress. Third, the association of low patient satisfaction could be explained by the fact that the treatment or care obtained during the consultation did not satisfy the patient's expectations. This could also be explained by the unsuccessful interaction between patient and doctor. Fourth, the fear of death could increase the patient's health-related introspection and thus produce or increase symptoms. Lastly, BMI above 30 as a risk factor for frequent attendance could be explained by increased functional impairment and higher morbidity among obese patients [27].

The previously found risk factors found also in this study were female gender [6,7,12,28] and former frequent attendance [10,29]. The threshold for consultation may be different for men and women [30] and also the persistent frequent attendance may be a result of learned habits to use health services. The previously found risk factors *not* found in our model were high age [10,12], chronic disease [3,7,12,14,28], and psychiatric and social problems [3,4,14]. The lack of high age as a risk factor could be explained by the fact that the study patients were a selected sample regarding age. The lack of the other previously found risk factors could be explained by the fact that instead

Table IV. Classified results of the questionnaires cross-tabulated with the outcome.

	Temporary FAs[1]		Persistent FAs[1]		
	n	%[2]	n	%[2]	p-value[3]
Sense of Cohererence[4]					
Low[5]	16	27	7	27	0.985
Alexithymia[6]					
Remarkable[7]	10	17	7	28	0.265
Difficulty describing emotions[8]	12	21	10	40	0.067
Difficulty identifying emotions[9]	20	34	13	52	0.135
Externally oriented thinking[10]	20	34	10	40	0.631
Fear of death[11]					
Remarkable[12]	12	20	12	46	<0.050*
Somatisation[13]					
Remarkable[14]	18	31	7	27	0.738
Hypochondria[15]					
Remarkable[16]	26	44	16	64	0.095

Notes: Results are given as number of respondents and percentage of those in the frequent attender (FA) class who provided a positive answer.
[1]Frequent attenders.
[2]Percentage of the class in this FA group.
[3]Bivariate analyses, categorical variables: Pearson's chi-squared test.
[4]13 item Sense of Coherence scale.
[5]Cut-off point <58.
[6]20-item Toronto Alexithymia Scale.
[7]Cut-off point >60.
[8]Toronto Alexithymia Scale subscale 1.
[9]Toronto Alexithymia Scale subscale 2.
[10]Toronto Alexithymia Scale subscale 3.
[11]This item was measured by a four-item Likert-scale questionnaire. Questions were: I am afraid of death. I am afraid that my close relative will die. I worry about the sorrow caused by my death to my relatives. I become distressed if I think that I won't exist any more one day.
[12]Cut-off point ≥14.
[13]Symptom Check List; somatisation subscale.
[14]Cut-off point ≥8.
[15]Whitely Index for measuring hypochondriac worries and beliefs.
[16]Cut-off point >6.

of a cross-sectional study we predicted persistent frequent attendance among the FA population. All these previously found risk factors were common among both temporary and persistent FA patients in our sample (see Tables I–V). A new observation was that the temporary FAs did not differ sufficiently from persistent FAs regarding these known risk factors for FA in total. Thus, when persistent frequent attendance is predicted, temporary frequent attendance should be handled separately.

All questionnaires used in this study were validated except the one measuring the fear of death. To improve the robustness of the modelling all the studied variables were first cross-tabulated with the outcome. After the modelling of the data, the inner and outer validity of the model were further tested. The main weakness of the study was the small number of study patients. A total of 43% of the random sample took part in the study. The study patients were older than the non-participating patients in the sample. Clinically speaking this difference is probably not relevant, because both children and elderly patients were excluded from the random sample.

One major advantage of the Bayesian model used, compared with a logistic regression model, is its ability to handle small data. The final Bayesian model was able to discriminate all the patients in spite of our small data. In the earlier phases of the modelling process it was used successfully for screening a large number of potential risk factors for persistent frequent attendance.

This model could quite easily be further developed as a practical decision support tool for general practitioners or healthcare administrators. The model with high specificity is appropriate to confirm the clinician's presumption of the patient's character. However, before use of this model beyond the setting, its external validity will need to be defined in different FA samples. The study patients were a selected sample by virtue of their age, chronic diseases, and education level. Currently the results of this study can be generalized only to this selected, but fairly common, group of primary healthcare patients.

Table V. Protective and risk factors explaining the persistent frequent attendance (FA).

Factors for FA persistence	Predicted class						Evidence strength					
	Temporary FA						Inversed (if temporary FA)					
Protective	%	95% CrI (%)		PO	95% CrI		%	95% CrI (%)		PO	95% CrI	
Male gender	80*	70.6	87.4	4.0*	2.4	6.9	36*	24.3	48.3	0.6*	0.3	0.9
Health centre visits <12	78*	68.0	85.5	3.5*	2.1	5.9	74*	62.5	84.3	2.8*	1.7	5.4
Body Mass Index <25	83*	74.6	90.2	4.9*	2.9	9.2	42	30.4	55.1	0.7	0.4	1.2
No fear of death	77*	66.7	84.5	3.3*	2.0	5.5	79*	68.1	88.4	3.8*	2.1	7.6
No alcohol abstinence	77*	67.6	85.3	3.3*	2.1	5.8	83*	72.0	90.9	4.9*	2.6	10.0
No irritable bowel syndrome	72*	61.6	80.5	2.6*	1.6	4.1	93*	84.7	97.7	13.3*	5.5	41.9
Moderate patient satisfaction	81*	71.3	88.1	4.3*	2.5	7.4	67*	55.2	78.6	2.0*	1.2	3.7
	Persistent FA						Inversed (If persistent FA)					
Risk	%	95% CrI (%)		PO	95% CrI		%	95% CrI (%)		PO	95% CrI	
Female gender	36*	26.8	47.0	0.6*	0.4	0.9	80*	62.9	92.3	4.0*	1.7	11.9
Health centre visits ≥12	48	37.8	58.8	0.9	0.6	1.4	54	35.1	71.8	1.2	0.5	2.5
Body Mass Index ≥30	55	44.7	65.5	1.2	0.8	1.9	42	25.0	61.3	0.7	0.3	1.6
Fear of death	50	40.1	61.0	1.0	0.7	1.6	46	28.2	64.9	0.9	0.4	1.8
Alcohol abstinence	53	42.9	64.0	1.1	0.8	1.8	44	25.0	61.3	0.8	0.3	1.6
Irritable bowel syndrome	55	44.7	65.5	1.2	0.8	1.9	20*	7.7	37.1	0.3*	0.1	0.6
Low patient satisfaction	58	47.1	68.0	1.4	0.9	2.1	44	25.0	61.3	0.8	0.3	1.6

Notes: Presented together with posterior odds (PO) and their 95% credibility intervals (Crl). CrI: 95% credibility intervals based on Jeffreys interval.

*Credible difference. According to CrIs, all protective factors are credible presenting good-to-moderate POs. However, only female gender is a credible risk factor (PO 0.6; 95% CrI 0.4–0.9). Thus, model gives good guidance for avoiding persistent frequent attendance and is a feasible proactive prevention model, but it does not predict the risk very well. Most notably, this is due to modest sample size in the frequent FA group, because the evidence strength for risk factors is only credible for female gender (PO 4.0; 95% CrI 1.7–11.9) and irritable bowel syndrome (PO 0.3; 95% CrI 0.1–0.6). The evidence strength for protective factors is credible for all variables except for BMI.

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Notes

[1]This item was measured by a four-item Likert scale questionnaire. Questions were: I am afraid of death. I am afraid that my close relative will die. I worry about the sorrow caused by my death to my relatives. I become distressed if I think that I won't exist any more one day.

[2]POs are given as PO = P_{PC}/P_{NPC} in which P_{PC} presents the probability of predicted class and P_{NPC} the probability of non-predicted class. Here, persistent FA was the predicted class.

[3]CrIs for the POs were estimated using the Jeffreys interval, a Bayesian CrI based on Jeffreys prior [26].

[4]BMI is a statistical measurement which compares a person's weight (w) in kilograms and height (h) in metres. BMI = w/h^2. BMI above 30 suggests that the person is obese.

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