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Medical school dropout - testing at admission versus selection by highest grades as predictors

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CONTEXT Very few studies have reported on the effect of admission tests on medical school dropout. The main aim of this study was to evaluate the predictive validity of non-grade-based admission testing versus grade-based admission relative to subsequent dropout.

METHODS This prospective cohort study followed six cohorts of medical students admitted to the medical school at the University of Southern Denmark during 2002–2007 ($n = 1544$). Half of the students were admitted based on their prior achievement of highest grades (Strategy 1) and the other half took a composite non-grade-based admission test (Strategy 2). Educational as well as social predictor variables (doctor-parent, origin, parenthood, parents living together, parent on benefit, university-educated parents) were also examined. The outcome of interest was students' dropout status at 2 years after admission. Multivariate logistic regression analysis was used to model dropout.

RESULTS Strategy 2 (admission test) students had a lower relative risk for dropping out of medical school within 2 years of admission (odds ratio 0.56, 95% confidence interval 0.39–0.80). Only the admission strategy, the type of qualifying examination and the priority given to the programme on the national application forms contributed significantly to the dropout model. Social variables did not predict dropout and neither did Strategy 2 admission test scores.

CONCLUSIONS Selection by admission testing appeared to have an independent, protective effect on dropout in this setting.

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INTRODUCTION

The overall net effect of medical school dropout on society, the medical profession, medical schools and the students who drop out is negative. We recently reviewed the literature on predictors of dropout in medical school and found that reported attrition rates in medical schools ranged from 2.4% to 26.2% and average 11.1% across studies.[1] Generally speaking, lower entry qualifications (broadly defined) seemed to be associated with greater risks of dropping out (odds ratios [ORs] 1.65–4.00). The effect of socio-economic, psychological and educational variables on dropout was generally not well investigated.[1] Only two studies included in the review examined the association between non-grade-based admission criteria and dropout.[2,3] Powis *et al.* examined 21 different admission interview subscales and subscores as predictors of dropout in a case–control study, and found only one of these to be significantly associated with dropout.[2] The number of negative comments assigned by interviewers to the subscale for supportive and encouraging behaviour was found to be associated with dropout (OR = 1.65, 95% confidence interval [CI] 1.01–2.70).[2] This result was statistically significant at 0.05%, although it may have occurred purely by chance. By contrast, Urlings-Strop *et al.* presented a more optimistic case for the protective effect of non-grade-based admission tests on student dropout.[3] They found that selected students were more than twice as likely as lottery-admitted control subjects to remain in school (relative risk [RR] 2.58, 95% CI 1.59–4.17; p = 0.000).[3] This study also referred to a third admission group ('direct access') consisting of students with the highest pre-university grade point averages (GPAs), but did not report a comparison of dropout rates between the 'direct access' and 'selected' groups.[3]

The effect of admission testing on dropout is probably influenced by both national and local settings. University education is still publicly funded and hence fee-free in Denmark. Furthermore, all students – irrespective of their socio-economic backgrounds and pre-university GPAs – have access to the same state grants and loans to cover living costs. In other words, the financial burden of dropout is mainly borne by taxpayers (and universities) and is only to a lesser extent felt directly by those who drop out and their families. Such a welfare-based approach may facilitate both access and subsequent attrition. In the years 2002–2007, the Faculty of Health Sciences, University of Southern Denmark (USD), initiated an educational admission experiment on all

programmes administered, including the medical programme. Important incentives for this educational experiment were the high ratios of applicants to available places ($\sim$ 5 to 6 : 1), and concomitant high rates of dropout from the medical programme, despite the fact that cohorts admitted over the years had mainly consisted of students with the highest pre-university GPAs. The student intake was divided into two admission strategy groups of approximately similar size. One half of the students (Strategy 1) were admitted directly based on their having the highest pre-university GPAs in the applicant pool. Strategy 2 applicants were admitted based on a non-grade-based selection process, which required them to turn up for admission tests at USD and to reflect on and defend their choice of programme and career, both in the application process and on the test day. Strategy 2 applicants needed only to comply with a set of minimum requirements pertaining to pre-university GPA subject levels and grades. The main aim of this paper is to report on whether or not admission strategy was independently associated with dropout. The objectives were: (i) to examine the effect of admission strategy on dropout while controlling for socio-demographic differences, and (ii) to present multivariate models of dropout.

METHODS

Design

This study was a prospective cohort study with 2 years of follow-up.

Participants

The population of interest consisted of all applicants admitted to the medical programme at USD in the years 2002–2007. Data on participants were collected from the student administrative database, a separate admission database for health science students, and a paper archive by a statistician and an assistant from the USD admission office in the spring of 2010. Hence, data collection for the six cohorts (2002–2007 cohorts) spanned from September 2002 to February 2010. The statistician was responsible for quality assurance of the extracted data. The USD data containing students' civil registration numbers – unique national person identification numbers – were saved to a CD by the statistician and sent to Statistics Denmark (http://www.dst.dk) by registered mail in early May 2010 by the researchers. Statistics Denmark extracted the relevant data from its data-

bases using the students' civil registration numbers. All datasets were then anonymised further by Statistics Denmark, by encryption of students' civil registration numbers to new unique identification numbers, the codes of which were unavailable to the researchers. Statistics Denmark then made all anonymised datasets (USD and Statistics Denmark data) available to the researchers via secured web access. Statistics Denmark does not allow any form of extraction of anonymised raw data and thus all data leaving Statistics Denmark must be aggregated (i.e. statistical output/analysed results) and simultaneously presented in a form that does not allow identification. The researchers complied fully with the rules and regulations imposed by Statistics Denmark and were unaware of participants' identities or civil registration numbers at all times. The regional ethics review committee exempted this project from full review.

Variables extracted from the university's databases

The variables obtained from USD databases were: admission strategy; pre-university GPAs; admission test scores; age on admission; admission year/cohort; dropout status; exam type; gender; priority, and transfer.

Admission strategy

Approximately half of the available places each year were assigned to Strategy 1 students, who were automatically admitted purely on the basis of having achieved the highest pre-university GPAs in the applicant pool. The other half of the available places were assigned to Strategy 2 students. Admission Strategy 2 consisted of applicants with minimum pre-university GPAs selected on the basis of a composite admission score derived from a non-grade-based admission test battery.

Admission test score

Details of the administration, scoring and reliability of the admission variables used (motivation, qualification, general knowledge and an admission interview) have been described at length elsewhere.[4] In short, participants who wished to be selected for admission tests were required to submit a written motivational statement to USD. The written motivation was in the essay format and was intended to allow the assessment of the applicant's written communication skills, knowledge of the chosen programme and profession, reflections on past experiences, reflections on choice of study, and future employ-

ment plans. Written motivations were rated by one staff member and given a score of 0–100 on a global rating scale.[4] In addition, applicants submitted a standard national application form, which contained specific questions developed according to a national coordinated application system, that is used for applications to all higher education programmes in Denmark. Scores were assigned (0–100 points) by one staff member for: relevance and quantity of previous work experience; past educational qualifications; foreign exchange experiences, and organisational or voluntary work. Those who scored well on these tools attended an admission test day during which they sat a test and were interviewed. The test was a general knowledge test that utilised 60 multiple-choice questions (MCQs) in a one-best-answer format to be answered in 15 minutes.[4] The content was broad and covered many subdomains, such as biology, physics, arts, news, music, health, politics, etc. The admission interview was a semi-structured interview designed to assess: subject interest; expectations; maturity for age; social skills; stress tolerance; empathy, and general interview behaviour. Applicant performance was scored on a global rating scale (0–100 points) by one staff member and one medical student.[4] The final admission test score was a weighted composite of scores for qualifications, general knowledge and the admission interview.

Dropout

Dates of the start and termination or completion of studies were registered for each student in the student administrative database. Dropout was defined as the termination of studies at USD within 2 years of study start for any reason (withdrawal, dismissal or transferral). Non-dropouts were students who were still active (delayed or on time) or had completed their studies.

Exam type

Pre-university exam types were divided into four categories: mathematics gymnasium (mathematics); language gymnasium (language); other Danish upper-secondary exam or special dispensations (other/disps.), and foreign exam (foreign). Mathematics and language categories are the traditional Danish preparatory exam for university education and are collectively referred to as 'general gymnasium' exams. They are based on upper secondary education programmes of 3 years' duration and are comparable with UK A-levels or US high school diplomas. The category of 'other/disps.' represents either exams taken after shorter courses (2 years), such as the higher preparatory exam, or exams that

aim to prepare students for vocations in business (higher commercial exam) or technical professions (higher technical exam).

Priority

The national coordinated application form allows applicants to apply for and prioritise between one and eight educational programmes simultaneously.

Transfer

Transfer refers to students who had previously been admitted to other programmes at USD.

Variables from Statistics Denmark

Data supplied by Statistics Denmark allowed us to generate the following social variables: Doctor parent, origin, parenthood, parents living together, parent on benefit, university educated father, university educated mother. These variables could only be extracted for Danish citizens for whom data were held by Statistics Denmark.

Doctor-parent

If a student was positively identified as having at least one parent with an MD degree, he or she was coded as having a doctor-parent.

Origin

Students were categorised into two main groups according to their origin, comprising those originating from the developed world, and those with origins in the developing world. The 'developed world' group was defined by Statistics Denmark as Europe (except Turkey, Cyprus, Azerbaijan, Uzbekistan, Kazakhstan, Kyrgyzstan, Georgia, Tajikistan and Armenia), Greenland, North America, Japan, New Zealand and Australia. The 'developing world' group contained all other countries. If a student or the student's mother were positively identified as an immigrant from the developing world, the student was designated as being of developing world origin. If a student had no mother, his or her father's origin would determine categorisation.

Parenthood

A student was defined as a parent if he or she had at least one child before the start of study.

Parents living together

If a student's biological parents were positively identified as sharing a family identity number (= address) in the admission year, they were categorised as parents living together. Death, divorce and separation are typical reasons for biological parents registered as not sharing a family identity number.

Parent on benefit

If a student was positively identified as having at least one parent on full income-replacing benefit of any type for a minimum of 360 days during the year of admission, he or she was categorised as having a parent on benefit.

University-educated father or mother

If a student was positively identified as having a university-educated father (or mother) holding a degree (Bachelor, Masters or PhD) achieved prior to the student's admission year, the student was categorised as having a university-educated father (or mother).

Analysis

Descriptions of all variables delivered by the USD Admission Office and Statistics Denmark were scrutinised to check for changes in data collection methods. The variables set forth in the research protocol were either prepared for analysis (educational/USD data) or generated by merging various datasets (social/Statistics Denmark variables). Missing data for the social variables generated from Statistics Denmark data were categorised with the non-event/reference category and summary tables were produced. Variables were then examined for co-linearity and zero cells before analyses, by inspection of matrix graph plots, 2×2 tables and boxplots. Individual predictors of dropout were then examined with univariate logistic regression analyses, and variables with $p < 0.1$ were eventually included in the multivariate models. Multivariate logistic regression was used to analyse the dichotomous outcome of dropout/non-dropout. Post-estimation diagnostics of models consisted mainly of checking linearity assumptions and influential data points. Additivity was assumed because we did not want to risk overfitting models by including interactions , due to the relatively large number of potential predictors and the modest number of dropouts. The linearity of the age variable was checked by inspecting LOWESS

(locally weighted scatterplot smoothing) smoothed plots, with the logit transformed probability of dropout on the y-axis against age on the x-axis. Influential cases or cases for which the model fitted poorly were identified by inspection of deviance residuals, leverage and Pregibon's delta-beta influence statistic.[5] Influential cases were inspected to establish whether they were outliers on any of the predictor variables in order to assess whether or not they should be removed from analysis.

RESULTS

In total, 1544 students were admitted to the medical programme at USD during the years 2002–2007. Dropout rates were 9.4% (145/1544) among all students, 11.6% (84/722) among students admitted under Strategy 1 (highest grades) and 7.4% (61/822) among students admitted under Strategy 2 (admission test). Table 1 lists the descriptive summary statistics for the total population of medical students ('all') as well as the subgroup of Danish citizens ('Danish'). Data on social variables were available for only the Danish subgroup via Statistics Denmark. The two admission strategy groups differed significantly in pre-university GPAs ($n = 1526$, $t = -47.20$, d.f. = 1524, $p < 0.000$); Strategy 1 students had higher pre-university GPAs (mean = 9.65, standard deviation [SD] 0.78) than Strategy 2 students (mean = 7.13, SD = 1.23). Table 2 presents univariate analyses and the multivariate model for dropout for the total population of medical students admitted ($n = 1544$). Strategy 1 admission (no admission test), higher age on admission, exam type (other/disps.) and giving the USD medical programme second or lower priority (not first priority) were all independently and significantly associated with increased risk of dropout. Table 3 shows univariate analyses and a multivariate model for the subgroup of medical students with Danish citizenship ($n = 1074$). The univariate analyses in Table 3 indicate that having a doctor-parent appeared to protect against dropout, as did having biological parents living together, whereas having at least one parent on benefit appeared to increase the risk for dropout. However, when all variables with $p < 0.1$ were entered into the multivariate model, none of the social variables specified retained statistical significance as independent predictors of dropout (Table 3). The surviving variables ($p < 0.05$) were all related to admission and included admission strategy, exam type and programme priority. In summary, students who were admitted based on admission tests (rather than high grades), students with general gymnasium examinations

Table 1 Medical students admitted to the University of Southern Denmark during 2002–2007

	Code		n	
	All	Danish	All	Danish
Admission strategy			1544	1074
Strategy 1	1	1	722	454
Strategy 2	2	2	822	620
Age, years	–	–	1544	1074
			Mean 22.82	Mean 22.88
			SD 3.29	SD 3.28
Cohort			1544	1074
2002 cohort	1	1	233	159
2003 cohort	2	2	255	164
2004 cohort	3	3	271	192
2005 cohort	4	4	252	181
2006 cohort	5	5	260	170
2007 cohort	6	6	273	208
Examination type			1544	1074
Mathematics	1	1	751	739
Language	2	1	127	127
Other/ dispensations	3	2	199	186
Foreign	4	2	467	22
Gender			1544	1074
Male	0	0	578	425
Female	1	1	966	649
Priority			1544	1074
First priority	1	1	917	706
Not first priority	2	2	627	368
Transfer			1544	1074
Not transferred	0	0	1402	945
Transferred	1	1	142	129
Doctor-parent				1074
No doctor-parent	–	0	–	785
Missing data		0		137
≥ 1 doctor-parent		1		152
Origin				1074
Developed world	–	0	–	959
Missing data		0		17
Developing world		1		98
Parenthood				1074
No children	–	0	–	1037
Parenthood		1		37
Parents live together				1074
No	–	0	–	231

Table 1 (Continued)

	Code		n	
	All	Danish	All	Danish
Missing data	0	132		
Yes	1	711		
Parent on benefit				1074
No	–	0	–	900
≥ 1 parent on benefit		1		174
University-educated father				1074
No	–	0	–	672
Missing data		0		116
Yes		1		286
University-educated mother				1074
No	–	0	–	883
Missing data		0		64
Yes		1		127
Dropout			1544	1074
No		0	1399	975
Yes		1	145	99

SD = standard deviation

(mathematics or language), and students who assigned first priority to the programme upon application had a decreased relative risk for dropout. No significant association was found between scores obtained on individual Strategy 2 admission variables (general knowledge MCQ test, qualifications, written motivation, admission interview) or the composite Strategy 2 admission score and dropout.

When missing data for the social variables from Statistics Denmark (Table 1) were coded as separate categories within each categorical variable, instead of being collapsed with the non-event reference group, and the subsequently entered into a multivariate analysis, the following findings emerged:

1 none of the 'missing sub-categories' were significantly different from the reference groups (non-event/0 category);
2 the statistical insignificance of the social variables within the final multivariate model did not change, and
3 the coefficients of the surviving significant variables in the multivariate model changed on the second decimal (exam type and priority) or

the third decimal (admission strategy), and the corresponding p-values for these changed on the third decimal only.

Based on these results, we decided to retain the categorisations presented in Tables 1–3.

Post-estimation diagnostics of the multivariate models (Tables 2 and 3) did not result in modifications. Having inspected the LOWESS plots for both models (Tables 2 and 3), we decided that linearity could be assumed for the variable age, although the model did not fit well for the youngest or oldest students. We chose not to try and model age in quadratic forms to ease interpretation of models. After inspection of influence statistics and influential cases we found no causes for removal of individual cases from analysis.

DISCUSSION

Key findings

The aim of this study was to examine whether admission strategy was independently associated with dropout while controlling for relevant educational and socio-demographic variables. Participation in an admission test, general gymnasium exam and being enrolled on a first-priority programme were all independently associated with a reduced risk of dropout. By contrast, socio-demographic variables had little or no independent influence on dropout (Tables 2 and 3). This study is, to the best of our knowledge, the first published study to compare admission testing and pure grade-based admission on the outcome of dropout in medical education.

Admission tests

The most consistent predictors of dropout in medical education are lower entry qualifications, broadly defined as, for example, not having a prior university degree, lower admission or aptitude test scores, lower summer school performance, lower formal pre-university academic qualifications, poorer non-academic qualifications, and lower extracurricular achievement.[1] In addition, there are now tentative signs that admission testing in medical education may offer added protection against dropout compared with both lottery admission and pure grade-based admission (Tables 2 and 3).[3] We found no significant association between Strategy 2 admission scores and dropout, but we suspect that restriction of range affected this result, since we studied only those students who had been admitted (representing the

Table 2 Predictors of dropout at 2 years after admission in all medical students admitted to the University of Southern Denmark during 2002–2007

	Univariate analysis		Multivariate model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Admission Strategy 2	0.61 (0.43–0.86)	0.005	0.56 (0.39–0.80)	0.002
Age	1.06 (1.02–1.11)	0.008	1.05 (1.00–1.11)	0.033
Cohort		0.739*	–	–
2003	0.86 (0.47–1.58)	0.632		
2004	0.73 (0.40–1.35)	0.318		
2005	1.13 (0.64–2.01)	0.670		
2006	0.93 (0.51–1.67)	0.800		
2007	0.80 (0.44–1.46)	0.469		
Examination type		0.000*		0.000*
Language	0.41 (0.15–1.16)	0.092	0.40 (0.14–1.14)	0.087
Other/disps.	2.89 (1.84–4.53)	0.000	2.49 (1.52–4.07)	0.000
Foreign	1.48 (0.99–2.22)	0.056	1.17 (0.76–1.79)	0.476
Female	0.95 (0.67–1.34)	0.757	–	–
Not first priority	1.59 (1.13–2.25)	0.008	1.88 (1.30–2.74)	0.001
Transferral	0.71 (0.36–1.39)	0.316	–	–
n			1544	
Pseudo R^2			0.050	

* P-value for the overall variable (cohort or examination type)
OR = odds ratio; 95% CI = 95% confidence interval of OR
Admission Strategy 1, the 2002 cohort and mathematics gymnasium examinations are reference categories

top 50% of Strategy 2 tested students). Therefore, although admitted Strategy 2 students were less likely to drop out than Strategy 1 students, we cannot be sure if or how much of this difference is associated directly with test scores (content). It is possible that the test situation itself (regardless of content) created the difference in that it may have led to better self-selection by those who were committed to medical training. One survey examined the causes of attrition amongst a whole cohort of students ($n = 3072$) admitted to Aarhus University in 1998.[6] Responses from 2295 students were included in the study. Of these respondents, 23.5% eventually dropped out, typically between 6 and 12 months from the start of study. Of the dropouts, 46% apparently functioned well, both academically and socially. However, most students in this category changed to another programme simply because they were disappointed with the content of the programme they had initially chosen.[6] Our Strategy 2 admission variables were designed precisely with the intent to counteract such mistakes by challenging applicants' choice of pro-

gramme and future profession. Our best guess, therefore, is that Strategy 2 led to the selection of students who, as a group, were more certain of their choices.

Pre-university GPA

We found that students admitted purely on the basis of having the highest pre-university GPAs had a larger relative risk of dropping out within 2 years of admission than did students admitted via admission testing (Tables 2 and 3). This may at first glance seem counter-intuitive, but it is important to remember that pre-university GPAs are just broad measures of basic academic skills, and not measures of motivation for any particular programme. Previously, Christensen and Juul[7] also found that pre-university GPA was not important to programme completion for medical students at another Danish university (Aarhus University) as long as the students were ranked above the fair–good level.

Table 3 Predictors of dropout at 2 years after admission for Danish medical students admitted to the University of Southern Denmark during 2002–2007

	Univariate analysis		Multivariate model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Admission Strategy 2	0.61 (0.40–0.92)	0.018	0.58 (0.37–0.90)	0.016
Age	1.08 (1.02–1.13)	0.006	1.04 (0.98–1.10)	0.167
Cohort		0.208*	–	–
2003	0.88 (0.38–2.06)	0.769		
2004	1.04 (0.47–2.29)	0.926		
2005	1.87 (0.90–3.88)	0.091		
2006	1.63 (0.77–3.46)	0.200		
2007	1.09 (0.51–2.35)	0.826		
Doctor-parent	0.37 (0.16–0.85)	0.020	0.51 (0.21–1.22)	0.129
Origin in developing world	0.62 (0.26–1.45)	0.271	–	–
No general gymnasium examination	3.26 (2.11–5.03)	0.000	2.56 (1.57–4.19)	0.000
Female gender	0.80 (0.53–1.22)	0.299	–	–
Parenthood	1.57 (0.60–4.12)	0.362	–	–
Parents live together	0.56 (0.37–0.84)	0.006	0.72 (0.46–1.13)	0.154
Parent on benefit	1.65 (1.00–2.72)	0.048	1.24 (0.71–2.14)	0.448
Not first priority	1.61 (1.06–2.44)	0.026	2.04 (1.31–3.18)	0.002
Transfer	0.91 (0.47–1.75)	0.773	–	–
University-educated father	0.87 (0.54–1.41)	0.573	–	–
University-educated mother	0.82 (0.42–1.63)	0.578	–	–
n			1074	
Pseudo R^2			0.072	

* P-value for the overall variable (cohort or examination type)
OR = odds ratio; 95% CI = 95% confidence interval of OR
Admission Strategy 1, the 2002 cohort and general gymnasium examinations (mathematics or language) are reference categories

Exam type

A number of Danish studies have shown that medical students (and other university students) with general gymnasium examinations achieve higher completion rates than students with other types of entry exam.[7–9] Our findings concur with these results. We found that Danish students without general gymnasium examinations were 2.56 times more likely to drop out than students with this examination type (Table 3). It appears that as long as Danish medical programmes cannot decide on entry exam requirements, they will be unable to combat a major predictor of dropout.

Priority

Not assigning first priority to the USD programme on the application form increased the odds of dropout by a factor of 1.88 for all medical students (Table 2) and 2.04 for Danish medical students (Table 3). Giving a programme second or lower priority was previously shown to be an independent and significant predictor of dropout in a university cohort admitted to Aarhus University in 1998.[6] It may be that the level of priority given to a programme by the applicant constitutes the simplest, most direct and reliable measure of motivation to study on that programme that is available. By stark contrast, our written motivational essay score was neither reliable nor associated with dropout.[4] Interestingly, test-based admission (Strategy 2) still seemed to have an independent protective effect against dropout.

Social background

Thomsen found that recruitment to Danish university programmes in 2002 was socially skewed.[10] The relative chance of studying at university was 6.8 times greater for students with university-educated parents than for those with parents with only elementary school education. In fact, this figure was even higher for the three medical programmes in Denmark in 2002 (ORs = 9, 15 and 21, respectively). Thomson purports, that success as a university student requires an individual to possess a 'social sense of direction' or 'habitus' that allows him or her to navigate successfully within the prevailing educational culture of a programme.[10] Such skills are supposedly passed on by university-educated parents to their children, thereby making the latter more successful in higher education.[10] Although such theories may be helpful in understanding socially skewed recruitment or perhaps socially skewed medical school grades, our results seem to contradict these theories to some extent because having university-educated parents did not seem to prevent students from navigating towards dropout (Table 3). Generally, there seems to be little existing evidence of significant associations between parents' educational level and dropout in either Danish university education or international medical education.[1,11–15]

We found that having a doctor-parent did not significantly protect against dropout (OR = 0.51; p = 0.129) in a multivariate model (Table 3). Previous research on the doctor-parent variable as a predictor of dropout in large UK cohorts also showed conflicting results.[14,15]

A Danish report of 2005 examined predictors for reaching the age of 25 years with no education. The following variables were found to be significant independent predictors: early parenthood; (lower) parent education levels; having a parent on long-term benefits; having a parent living in a block of flats; having parents who do not share the same address, and having ethnic origins in the developing world.[16] We found no significant effect on medical school dropout of comparable social variables (Table 3).

Limitations of this study

The major limitation of this study is the potential bias introduced missing data in the data supplied by Statistics Denmark. We do not, know if data were missing at random or not and thus it is difficult to determine the direction and magnitude of the bias. There is also some potential for the misclassification of variables as data were retrieved and pieced together from different sources (databases, archive), coded, and merged. Our main focus was on evaluating the effect of admission testing and other relevant predictors at the point of admission. We recognise that we may have omitted relevant explanatory variables in our model and hence presented biased coefficients. Similarly, more comprehensive dropout models which specify both admission and post-admission factors, and use more sophisticated analyses (e.g. structural equation modelling) may yield a different set of explanatory factors and coefficients. However, smaller samples of dropouts require the level of ambition to be adjusted correspondingly. We deliberately chose to use dropout rates at 2 years after the start of study as our outcome to ensure the largest possible sample sizes, but of course our analysis is limited by the fact that we did not follow everybody to either dropout or programme completion. As it happens, we did find that, had we chosen dropout rates at 3 years from study start as our outcome (i.e. by excluding the admission cohort of 2007 from analysis), the same variables (Table 2) would survive in a multivariate model, and the OR for admission Strategy 2 would change on the second decimal only (data not presented). The generalisability of our results is uncertain. Whether similar findings on admission testing versus grade-based admission can be reproduced in other settings remains to be seen. Our hope is that others will be interested in testing whether there is an independent association between admission test survival and programme retention regardless of admission test content, prior grades and setting.

CONCLUSIONS

Admission testing was found to be superior to pure grade-based selection when the outcome was student dropout within 2 years of the start of study. The type of qualifying exam held by an applicant and the priority assigned by the applicant to the programme were also significant predictors of dropout. Selected social background factors did not seem to be related to medical school dropout.

REFERENCES

1 O'Neill L, Wallstedt B, Eika B, Hartvigsen J. Factors associated with dropout in medical education: a literature review. *Med Educ* 2011;**45** (5):440–54.

2 Powis DA, Waring TC, Bristow T, O'Connell DL. The structured interview as a tool for predicting premature withdrawal from medical school. *Aust N Z J Med* 1992;**22** (6):692–8.

3 Urlings-Strop LC, Stijnen T, Themmen APN, Splinter TAW. Selection of medical students: a controlled experiment. *Med Educ* 2009;**43** (2):175–83.

4 O'Neill L, Korsholm L, Wallstedt B, Eika B, Hartvigsen J. Generalisability of a composite student selection programme. *Med Educ* 2009;**43**:58–65.

5 Menard S. *Applied Logistic Regression Analysis*, 2nd edn. Thousand Oaks, CA: Sage Publications 2002;80–91.

6 Studenterrådet ved Århus Universitet [Aarhus University Student Council]. Frafald og Studiemiljø. Aarhus: Studenterrådet ved Århus Universitet 2000. http://sr.au.dk/PDF/frafald/forord.pdf. [Accessed 22 June 2011.]

7 Christensen J, Juul S. [Admission qualifications and medical education in Denmark.] *Ugeskr Laeger* 1999;**161**:257–62.

8 Jensen D, Plannthin M. *De Almengymnasiale Uddannelser og Universitetet.* Copenhagen: Institute of Economics, Copenhagen University 1997.

9 Teilmann E. *Den Grønne Årgang – en Forløbsanalyse af Årgangen 1995.* Aarhus: Aarhus University 1997.

10 Thomsen JP. Forskelle på danske universitetsuddannelser. *Samfundsøkonomen* 2005;**5**:1–8.

11 Ward AM, Kamien M, Lopez DG. Medical career choice and practice location: early factors predicting course completion, career choice and practice location. *Med Educ* 2004;**38** (3):239–48.

12 Strayhorn G. Participation in a premedical summer programme for under-represented minority students as a predictor of academic performance in the first three years of medical school: two studies. *Acad Med* 1999;**74** (4):435–47.

13 Willoughby TL, Arnold L, Calkins V. Personal characteristics and achievements of medical students from urban and non-urban areas. *J Med Educ* 1981;**56** (9):717–26.

14 Arulampalam W, Naylor R, Smith J. Factors affecting the probability of first year medical students' dropout in the UK: a logistic analysis for the intake cohorts of 1980–92. *Med Educ* 2004;**38**:492–503.

15 Arulampalam W, Naylor R, Smith JP. Dropping out of medical school in the UK: explaining the changes over 10 years. *Med Educ* 2007;**41**:385–94.

16 Glavind N. *Lighed gennem uddannelse – hvordan er det gået?* Copenhagen: Arbejderbevægelsens Erhvervsråd 2005.