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Success at Veterinary School: Evaluating the Influence of Intake Variables on Year 1 Examination Performance

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55 **Abstract**

56

57 A major challenge in admissions to veterinary medical degrees is to select those students
58 with most suitability for clinical training programmes and careers from a large pool of
59 applicants with very high academic ability. Predicting the success of students in a
60 veterinary course is challenging and relatively few objective studies have been undertaken
61 to identify factors that will facilitate progression through this educational experience. Prior
62 educational attainment is considered by some to be a good predictor of success at
63 undergraduate level.

64 The aims of study were to analyse intake data such as educational history and
65 demographic factors of students entering the University of Edinburgh and to investigate
66 possible relationships between these data and academic performance in the first year at
67 veterinary school.

68 Data were collated for three veterinary intakes including school qualification, subjects,
69 grades, Grade Point Average (GPA), degree classification, domicile, gender and age.
70 Performance was measured by marks achieved in first year veterinary degree
71 examinations. Relationships between marks and the influence of intake variables were
72 statistically analysed via analysis of variance. For school-leaving entrants, the presence of
73 straight As in school was linked to a better exam performance. Students with an A in
74 Chemistry or Biology performed better; Mathematics and Physics did not show a
75 consistent linkage with performance. Higher GPA was associated with better performance
76 in first year for students on a graduate entry programme.

77 This study shows that prior educational attainment does appear to be linked with
78 subsequent performance in the first year at veterinary school.

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84 **Key words:** veterinary admissions, predictors of success, undergraduate
85 selection, student performance

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99 **Introduction**

100

101 Predicting the success of students in an undergraduate clinical veterinary course is
102 challenging and relatively few objective studies have been undertaken to identify factors
103 that will facilitate progression through this educational experience. There are two main
104 ways of assessing the success of student selection procedures into professional clinical
105 degree programmes: ability to complete the undergraduate course and success and
106 competence in a subsequent career (e.g. how “good” a vet or doctor you become). Most
107 studies on success and selection in medicine focus on performance in medical school
108 rather than how “good” a doctor you become; indeed more work is needed to determine
109 further the link between performance at medical school and subsequent success in the
110 postgraduate domain.¹ In reality, students in courses such as veterinary medicine should
111 be selected both for their ability to succeed in the course and also in their future
112 profession²; ideally the two aspects should be aligned. According to the Schwartz Report
113 in the UK on Fair Admissions to Higher Education, identifying “latent talent and potential
114 which may not fully be demonstrated by examination results” is a legitimate aim in
115 selection processes.³ Equally, according to that report, prior educational attainment data
116 remain the best indicators of success at undergraduate level and accordingly, evaluation of
117 academic history remains central to the admissions process.

118

119 Previous academic performance (e.g. high school A-Level [AL] results) is considered by
120 some to be the best predictor of the outcome at medical school.⁴ Research from the USA
121 has shown that in the veterinary course, academic difficulty experienced by veterinary
122 students was associated with a low pre-requisite Grade Point Average (GPA) achieved
123 prior to admission.⁵ Kogan et al.⁶ also showed that a higher incoming GPA was linked with
124 better performance on course. In a study from South Africa, previous academic
125 performance was positively correlated with academic performance at veterinary school.⁷
126 One of the earliest studies in the veterinary setting in the UK found a correlation between
127 entrance grades and performance in veterinary school.⁸ A veterinary study from Austria
128 showed that previous school performance was the best predictor of performance in first
129 year examinations for the Austrian (but not German) cohort of students.⁹ A further study
130 from the same group in Austria has shown that the move to a selective admissions
131 process (including evaluation of previous school performance) from a non-selective
132 process was correlated with success in first year veterinary examinations.¹⁰ More recently,
133 again in a study from the USA, Molgaard et al.¹¹ showed that previous academic
134 performance such as undergraduate GPA was predictive of performance at veterinary
135 school. GPA was also found to be predictive of performance in the first two (preclinical)
136 years at a US veterinary school.¹²

137

138 In terms of the best pre-requisite subjects to facilitate veterinary undergraduate training,
139 there is limited objective published information. Muzyamba et al.¹³ in a study in the UK,
140 found that A-Level results in Chemistry, Biology and a third subject were predictive of
141 performance in the early years of the veterinary course. In contrast, workers in the USA did
142 not find any significant correlation between pre-veterinary course parameters and the class
143 rank of third year veterinary students.⁶ In the medical arena, a correlation has been
144 demonstrated between performance in the medical course and performance in A-Level
145 Chemistry and Biology¹⁴⁻¹⁷ but interestingly, not Maths or Physics.¹⁴

146

147 However, there are contrasting reports both in medicine and veterinary medicine in terms
148 of the impact of a variety of demographic factors such as age and gender on the
149 performance of students on these clinical courses.^{5,18,19,20}

150

151 The aim of this study was to analyse intake data such as educational history and
152 demographic factors of students entering a traditional 5 year veterinary degree programme
153 (5 year) and a 4 year accelerated graduate entry programme (4 year) at the University of

154 Edinburgh. Possible relationships between these data and academic performance in the
155 first year at veterinary school were investigated.

156 **Materials and Methods**

157

158 *Data Collection and analysis*

159

160 At the University of Edinburgh, there are two veterinary degree programmes: a traditional 5
161 year programme (5 year) and a 4 year accelerated graduate entry programme for
162 graduates holding an appropriate biological or animal science degree (4 year). The
163 majority of entrants to the 5 year programme come from high school with their school
164 qualifications being assessed for entry; this is the usual pathway into veterinary medicine
165 in the UK, unlike North America where graduate entry is more common. However, in
166 recent years graduate entry is becoming increasingly common in the UK. School-leaving
167 applicants from the UK (excluding Scotland), and some international students, usually
168 apply presenting with the school qualification known as A-Level. For the entrants in this
169 study, the A-Levels were those presented and graded according to a five-point scale (A, B,
170 C, D, E) from examinations sat at around 17 to 18 years of age. The minimum
171 requirements for entry into the University of Edinburgh veterinary degree programme for
172 the non-graduate cohorts studied were AAB at General Certificate of Education (GCE) A-
173 Level, meaning three A-Levels with awarded grades A, A and B. In Scotland, school-
174 leaving applicants apply presenting with the school qualifications known as Highers and
175 Advanced Highers which are usually sat in the last two years of high school by pupils aged
176 around 16 to 18 years of age. Highers and Advanced Highers are graded according to a
177 four-point scale (A, B, C, D). For Scottish-domiciled applicants, the minimum requirements
178 were AAABB at Scottish Qualifications Authority (SQA) Higher Level and BB at Advanced
179 Higher Level; this means five Highers with awarded grades A, A, A, B, B and two
180 Advanced Highers with awarded grades B and B. UK undergraduate degrees can be
181 classified as first class with a final mark $\geq 70\%$ or upper second class with a final mark of
182 60-69%; there are also further classifications below these marks. For graduate applicants,
183 the preferred requirements were a minimum of an upper second class degree (2i), or a
184 minimum grade point average (GPA) of 3.4 (on a four point scale). Data encompassing
185 entrant background information were collected and collated for three consecutive annual
186 intakes (2007, 2008 and 2009).

187

188 Data on entrants from high school included: school qualification (e.g. A-Level, Highers,
189 Advanced Highers), subjects taken including grades, school type (state or independent),
190 whether a gap year was taken, gender and age (<21 years or not). It was recorded
191 whether the A-Levels were obtained in the UK or not. Particular additional data collected
192 for graduate entrants included degree classification (UK 1st or 2i), whether the degree was
193 from the UK, rest of the European Union (rEU) or elsewhere in the world (RoW), student
194 domiciled in the rEU or North America prior to starting BVM&S course, grade point
195 average (GPA on a 4.0 point scale) and years elapsed between award of degree and
196 starting veterinary school. Therefore, RoW applicants would include some students from
197 North America presenting with an undergraduate degree. Entrants were divided into
198 whether they were entering the 5- or 4-year BVM&S course and, within that, they were
199 initially subdivided into four 5-year groups (UK/rEU Scottish Funding Council-funded [SFC]
200 school leavers, RoW school leavers, UK/rEU graduates and RoW graduates) and two 4-
201 year groups (UK/rEU graduates, RoW graduates). Any A-Level or Advanced Higher results
202 from graduate entrants were ignored (not factored into the analysis) as the research focus
203 was the highest (or most recent) qualification evaluated as part of the admissions process
204 for entry to the veterinary school.

205

206 The calibre of an entrant's academic institution as profiled by reference sources (Barron's
207 Profiles of American Colleges²¹ and University league tables) was also determined (bands
208 A to C, see below). Universities in the UK and rEU were ranked by using the Top
209 European Universities guide (2008 rankings²²). The overall scores in the Top European
210 Universities in this guide ranged from 98.9% - 33.8%. The percentage rankings were

211 classified into 3 equal bands within these parameters (A, B and C, universities in
212 descending order of score band). Where UK and rEU universities did not appear in the
213 above European rankings, a combination of the world University rankings²² and the Times
214 Good University Guide²³ was used to establish a relevant ranking. These Universities were
215 below the lowest score published on the Top European Universities and hence they were
216 subsequently all ranked as band C. If the institution was not in either guide, a rank of C
217 was ascribed.

218
219 The Barron's Profiles of American Colleges, 27th Edition²¹ was used to rank USA
220 Universities and Colleges. This profiling resource ranks institutions according to
221 admissions competitiveness. These institutions were then separated into bands A, B and C
222 using the following method: A (corresponding to Barron's classification of 'Most
223 Competitive'; 'Highly Competitive'), B ('Very Competitive') and C ('Less Competitive',
224 'Competitive+', 'Competitive'). There were some instances whereby two categories were
225 ascribed for a student, for example, 'Competitive' and 'Most Competitive' as the student
226 had studied at two institutions in order to obtain a degree qualification but would only
227 graduate from one. In these cases, the institution where the student had been awarded the
228 degree qualification was used. The rankings of Canadian universities were firstly taken
229 from the world rankings.²² Next, each Canadian university was compared with the nearest
230 ranked USA university and then assigned the ranking of A, B or C from this comparison.

231
232 The student cohorts were tracked and the results of the examinations for their first year at
233 veterinary school were collected. Performance was measured by the marks achieved in
234 first year degree examinations. Only the results from the student's first attempt of the
235 particular examination diet were used for analysis; i.e. re-sit results were not used. These
236 marks were the average percentage for the whole year (0-100%) weighted by the number
237 of credits that courses within the year had accredited to them. Because of the
238 heterogeneity of subjects studied in individual years and differing teaching and
239 assessments between 4 year and 5 year degree programmes, the exam results were
240 calculated as an average percentage for the whole year. In the first year (of both the 5 year
241 and 4 year programmes) at Edinburgh, subjects covered include studies of the animal
242 body (incorporating anatomy, physiology, cell biology, biochemistry, introductory
243 pathology, animal health and welfare).

244
245 The relationships between marks and the influence of intake variables were statistically
246 analysed using analyses of variance. Normality of residuals was confirmed prior to
247 reporting of analyses. For all analyses, the cohort that the student formed part of was
248 initially added into the statistical model as a first fixed effect. Other explanatory variables
249 were then added to the model. For analysis of grades in examinations undertaken prior to
250 entry into the vet school, the type of grade - Scottish Advanced Higher, Scottish Higher, A-
251 Level and GPA, and the University A-C rank described above - were considered
252 separately. There were not enough students (9) that started the five year programme that
253 had graduated from a non UK/rEU university for them to be considered as a separate
254 group to UK/rEU graduates and so these two groups were combined for the analyses.
255 Analysis of variation in marks and pass rates in the three 5-year groups (UK/rEU SFC
256 school leavers, RoW school leavers, UK/rEU/RoW graduates) and the two 4-year groups
257 (UK/rEU graduates and RoW graduates) were considered separately as the 2 programmes
258 differed markedly in teaching material. All analysis was carried out in R (V3.3.1 © The R
259 Foundation for Statistical Computing), and $P < 0.05$ was taken to indicate statistical
260 significance.

261
262 This Admissions research study was approved by the College of Medicine and Veterinary
263 Medicine Ethics Committee at the University of Edinburgh.

264

265 Results

266

267 The three entrant cohorts totalling 448 students consisted of 130 students in 2007 (93 in 5
268 year programme and 37 in 4 year), 147 in 2008 (98 in 5 year and 49 in 4 year) and 171 in
269 2009 (105 in 5 year and 66 in 4 year). The attributes of these students are summarised in
270 Table 1.

271

272 (Place Table 1 here)

273

274 Fourteen of the entrants (3.0% : 7 UK/rEU SFC-funded school leavers, 2 graduates on the
275 5 year programme, 5 graduates on the 4 year accelerated programme) withdrew before
276 the end of their respective first year, precluding any analysis of the end of year mark for
277 these entrants, leaving 434 students with end of year examination marks. As only 3% of
278 the entrants withdrew before the end of the year, the statistical power associated with any
279 analysis of whether withdrawal was dependent on any of the variables was likely to be low,
280 and therefore the lack of statistical significance for any variable was not surprising
281 ($P>0.125$). Over 90% of entrants (93.1%, 404 of 434) passed ($\geq 50\%$ for average Year 1
282 mark) their first year at the first attempt, again limiting the power likely to be associated
283 with any analysis.

284

285 *End of Year 1 examination mark*

286

287 The end of Year 1 performance marks are summarised in Tables 2a and 2b. There was a
288 statistically significant difference between the 5 year overall end of year 1 mark (64%)
289 compared to the 4 year mark (60%, $P<0.001$, Table 2a). The average end of year 1
290 examination marks did not statistically significantly differ between either the three 5 year
291 groups of entrants (63-64%, $P=0.879$; or the two 4 year groups of entrants (60%, $P=0.975$,
292 Table 2a). In addition, there was no statistically significant difference between cohorts in
293 either the 5 year or 4 year programmes ($P>0.052$, Figure 1a), nor was there any
294 statistically significant interaction between cohort and either the three 5 year groups of
295 entrants ($P=0.891$) or the two 4 year groups of entrants ($P=0.763$, Figure 1b).

296

297 (Place Table 2a here)

298

299 For school-leaving entrants to veterinary school, the presence of straight As in school
300 subjects (A-Level [AL], Advanced Higher [AH] and Higher) was linked to statistically
301 significantly better exam performance in end of first year examinations compared to
302 students with grades less than A ($P<0.001$; AL: 67% vs 60%, AH: 67% vs 59%, Higher:
303 64% vs 57%; Table 2a, Figure 2a). However, this was not dependent on whether UK AL
304 were taken or not ($P=0.055$, Table 2a).

305

306 While there was no statistically significant cohort-dependent effect with the A Level results
307 ($P=0.205$), there was a significant cohort effect with whether school-leaving entrants
308 achieved all grade A in their AH ($P=0.023$, Figure 2a) : there was no statistically significant
309 difference in the end of year mark in the Entry Cohort 2 (2008) with whether the school-
310 leaving entrants achieved all As in their AH ($P=0.318$, All A:61%, Not all A:59%), but the
311 statistically significant difference remained for Entry Cohorts 1 and 3 (2007 – All A: 73%,
312 Not all A: 60% - and 2009 - All A: 69%, Not all A: 58%% -, Figure 2a, $P<0.003$).

313

314 If just whether school-leaving entrants had obtained an A in Biology was considered, again
315 there were statistically significant differences ($P<0.001$; AL: A 67% vs <A 50%, AH: A 65%
316 vs <A 58%, H: A 63% vs <A 49%; Table 2a, Figure 2b), and again this was not entry
317 cohort dependent ($P>0.477$), nor was the AL difference UK/non-UK dependent ($P=0.881$).
318 In addition, school-leaving entrants gaining an A in AH Chemistry had statistically
319 significantly higher end of first year examination marks ($P<0.001$, 65% vs < A 57%, Figure

320 2c, Table 2a), with too few school-leaving entrants (N=4) obtaining less than an A in AL
321 Chemistry to facilitate analysis. The reason for this is that, in the main, candidates with
322 less than A in AL chemistry are not admitted due to the entrance requirements. In contrast,
323 no statistically significant differences in end of first year examination marks were observed
324 depending on whether school-leaving entrants had obtained an A or not in either
325 Mathematics (at AL or AH) or Physics (at AL, AH or H) ($P>0.090$, Table 2a).

326
327 As mentioned above, for those Scottish-educated students that would have also taken
328 Highers, as with the Advanced Highers, there was statistically significantly better exam
329 performance in end of first year examinations with straight As compared to students with
330 grades less than A ($P<0.001$; 64% vs 57%, Table 2a, Figure 2a), and this was not entry
331 cohort dependent ($P=0.895$). In addition, this statistically significant effect remained if just
332 whether a grade A Higher was obtained in Biology ($P<0.001$; A 63% vs < A 49%, Table 2a,
333 Figure 2b) and Mathematics ($P=0.038$; A 63% vs < A 58%, Table 2a, Figure 2d), but no
334 statistically significant differences were observed with Physics ($P=0.116$; A 63% vs < A
335 57%) and Chemistry ($P=0.359$; 62% vs 57%; Table 2a). Again, very few candidates are
336 accepted with < A in Higher Chemistry as this is a minimum entry requirement.

337
338 There was some evidence of differences in year 1 performance if school-leaving entrants
339 from the UK had been to an independent (66%) or state school (63%, $P=0.028$, Table 2a),
340 though the impact was not large (Figure 3a). However, there was a statistically significant
341 interaction between school type and whether a grade A had been obtained in an AH
342 Biology ($P=0.001$), with a greater difference in exam performance between those Scottish
343 school-leaving entrants that attended an independent school (A: 68%, <A: 48%) compared
344 to a state school (A: 64%, <A: 60%, Table 2a, Figure 3b). This statistically significant
345 difference was not reflected in the differences in average marks between those school-
346 leaving entrants that had or had not achieved either all As in Highers or A in a particular
347 Higher subject ($P>0.112$).

348
349 Only two of the 21 graduates on the 5 year programme obtained a UK 1st class degree,
350 precluding any statistical analysis of a 1st compared to a 2i. For the 4 year programme,
351 there was no statistically significant improvement in exam performance of graduates with a
352 1st compared to a 2i ($P=0.057$, Table 2b). In addition, in graduate entrants from outside the
353 UK on the 5 year programme there was no improved exam performance in those with a
354 higher GPA (≥ 3.4) ($P=0.964$, Table 2b). In contrast, in graduate entrants from outside the
355 UK on the 4 year programme there was a statistically significantly improved exam
356 performance in those with a higher GPA (≥ 3.4) compared to those with a GPA < 3.4 (62 vs
357 56%, $P=0.015$, Table 2b, Figure 4). For all entrants, increased age (≥ 21 years of age) at
358 the onset of veterinary studies was associated with a statistically significantly reduced
359 exam performance ($P=0.003$, ≥ 21 : 61%, <21: 64%, Table 2b). However, this is
360 confounded by whether entrants have done a degree or not, as no entrants with a previous
361 degree were <21, and only 2% of school entrants were ≥ 21 . If entrants were sub-divided
362 into whether a school leaver or with a previous degree, then there was no statistically
363 significant relationship between actual age and exam performance in either group
364 ($P>0.262$).

365
366 (Place Table 2b here)

367
368 No statistically significant association with exam performance was found for any of the
369 other variables (gender, domicile, whether a gap year was taken, time elapsed since
370 previous study, where degree was obtained or university grade) in both the 4- and 5-year
371 programmes ($P>0.131$, Table 2b).

372
373
374

375 Discussion

376

377 This study showed that some intake variables, primarily previous academic history, were
378 associated with subsequent academic success or otherwise in the first year at veterinary
379 school. In the veterinary setting, most studies show a link between prior attainment and
380 performance in the early years^{9,11,12} with fewer showing a link with performance in later or
381 final years.⁷

382

383 This study encompassed three entry cohorts (2007, 2008 and 2009); this had the benefit of
384 generating a large sample size for analysis and allowed the identification of any particular
385 cohort effects. Although there were occasional cohort effects, these were not common and
386 it was still possible to draw conclusions about the impact of intake variables independent of
387 particular cohort effects. It is important to note that the analysis of veterinary school results
388 for the students was on the basis of their first attempt at the exams, rather than re-sits; it
389 was considered that this was the best way of comparing students with their peers in
390 relation to their intake variables and when sitting the same schedule of exams. In each diet
391 of exams, there is a small number of students who sit the exams with special
392 circumstances (e.g. ill health) and they are allowed to then sit the exam at a later re-sit
393 diet, but have this subsequent attempt viewed as a first attempt. Also, there is a small
394 number of students who move between cohorts e.g. if they dropped down a year due to
395 intercalating studies or having to repeat a year; it was not possible to track these students
396 in this study. Therefore, it was considered that the small number of students who fell into
397 this category would not impact the statistical evaluation of the large dataset of the first
398 attempt results of the entire year cohorts. This small group of students could potentially be
399 looked at in future studies, but it would be difficult to draw conclusions owing to the small
400 numbers involved.

401

402 Students (school-leaving entrants) that had straight As in high school subjects achieved
403 better exam performance in the first year at veterinary school. When evaluating the impact
404 of school subjects studied, it was found that Biology and Chemistry had more effect on
405 subsequent performance than Maths and Physics. This is largely in agreement with the
406 findings in veterinary medicine¹³ and medicine^{14,15,17} where prior attainment in Chemistry
407 and Biology is linked with performance on course. An exception to this trend was the
408 finding from an Italian veterinary study where the performance in the Biology section of an
409 admissions test was not linked with performance on course; accordingly the Biology
410 requirement in the test was removed.²⁴ Furthermore, Muzyamba et al.¹³ found that
411 performance in the third A-Level subject (in addition to Chemistry and Biology) was linked
412 with performance in the early years at vet school and Montague and Odds¹⁴ found that A-
413 Level Maths and Physics grades had no correlation with performance at medical school. In
414 this current Edinburgh study, an A in Biology at AL, AH and H was linked with better exam
415 performance; similarly, an A in AH Chemistry was associated with better exam
416 performance. It was unsurprising that an effect of AL and H Chemistry on subsequent
417 performance was not observed; this is because at the time of entry an A in these
418 qualifications was a minimum entry requirement, so that there were too few students
419 entering the course with < A to permit statistical analysis. Interestingly, although the effect
420 of Maths was not as strong as Chemistry and Biology, an A in H Maths was associated
421 with better performance in Year 1.

422

423 There was a small effect of the type of school attended (state vs independent) on exam
424 performance, with students who attended an independent school doing slightly better. For
425 Scottish-educated students, this effect appeared to be counter-balanced by a greater drop
426 off in performance in students who achieved < A in AH Biology from an independent
427 school compared to students from a state school. There are limited reports detailing the
428 impact of school type on performance in veterinary medicine and medicine. Muzyamba et
429 al.¹³ reported that students from independent school were more likely to pass final year in

430 a UK veterinary degree. Lumb and Vail¹⁸ found that school type had no effect on
431 performance in the third year of medical school. In contrast, in a study at the University of
432 Edinburgh across a broad range of subjects from humanities to sciences, students from
433 independent schools did not achieve as good outcomes in their degrees as peers from
434 state schools.²⁵

435
436 For graduate entrants to the 4-year programme, prior educational attainment such as GPA
437 ≥ 3.4 was linked with better exam performance. The apparent effect of increased age
438 negatively impacting exam performance was likely due to the confounding effect of being a
439 graduate. The literature regarding the impact of age on performance is conflicting with
440 some studies showing that, in the veterinary setting, increased age (≥ 35 years) was linked
441 with academic difficulty⁵ and that, in a medical study, older students were more likely to
442 have difficulty passing the final degree.¹⁵ However other studies in the medical setting
443 reported that age had no impact on performance¹⁸ or knowledge acquisition.²⁰

444
445 Furthermore, although on face value it would appear that the 5-year students performed
446 better in first year when compared to the 4-year students, this comparison is not really
447 realistic. The respective two courses that these students are taking are completely
448 different, both in terms of delivery and assessment; accordingly one is not comparing 'like
449 with like'.

450
451 There was no effect of any of the other variables on performance in the first year at
452 veterinary school for either the 5-year or 4-year programmes; these variables were gender,
453 domicile, whether a gap year was taken, time elapsed since previous study, where degree
454 obtained and university grade. A potential limitation of this study is the difficulty in
455 characterizing and ranking the wide range of educational and personal background
456 experiences of the candidates applying to our veterinary school. However, the groupings
457 and characterization of the candidates as detailed above (including GPA preferred
458 minimum entry thresholds, Barron's Profiles of American Colleges and university league
459 tables etc.) made some attempt to evaluate the 'heterogeneous' nature of the veterinary
460 school applicants, including their educational histories.

461
462 Therefore it can be seen that prior educational attainment does appear to be correlated
463 with performance in the first year at veterinary school. Biology and Chemistry appear to
464 have the greatest impact, with Biology having slightly more of an effect than Chemistry.
465 These subjects have more of an effect than Maths and Physics; this perhaps has
466 implications on the existing perceptions regarding the entry criteria (both in terms of
467 required subjects and grades) that a particular institution sets for entry onto the veterinary
468 course. For instance, at Edinburgh, insisting on an A in Chemistry (at AL and H) as an
469 entry requirement for entry was in place at the time of these study cohorts rather than
470 insisting on the same for Biology, which is now the case. In addition, at the time of the
471 study cohorts, the preferred requirements for AL were Chemistry, Biology and one of
472 Physics/Maths. The results of this study suggest that pre-requisites might be changed
473 without negatively impacting performance in the first year at veterinary school. The results
474 of the intake studies provided an evidence base to help inform the University of
475 Edinburgh's Veterinary Admissions Committee's decision to change the subject entrance
476 requirements and the number of A grades required (since 'all As' was linked with better
477 performance). Subsequent to these cohorts, admissions requirements have been changed
478 to AAA at AL and AAAAB in Highers (with A in both Chemistry and Biology, rather than just
479 Chemistry); Also the requirement for the third subject at A-Level to be Maths or Physics
480 has been removed, in favour of a third approved subject (from a large list of subjects); this
481 adds flexibility to an applicant's subject choices and also may add to the breadth of
482 educational experience that students have before university.

483
484 All veterinary schools are always trying to refine and improve their admissions process in
485 the knowledge that a successful admissions process will ultimately lead to a better

486 teaching and student experience on course, and hopefully on into postgraduate life. It is
487 clear that admissions research with linkage into the teaching continuum is needed; this will
488 help future evidence-based development of admissions processes. Furthermore,
489 identification of patterns and predictors for success on our course will allow institutions to
490 identify 'at risk' students and tailor our teaching programme and associated support
491 mechanisms accordingly.

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648 **Figure Captions**

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650 **Figure 1:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3
651 entry cohorts (2007, 2008 and 2009: EC 1-3) that completed their first year and had
652 started (a) either the 5- year or 4- year accelerated graduate entry programme; (b) had
653 started the 5- year programme as a school-leaver, either UK/rest of EU (rEU) Scottish
654 Funding Council-funded (SFC) or rest of the world (RoW)); or had graduated either from a
655 UK, rest of the EU or rest of the world university (UK/rEU/RoW); or had started the 4- year
656 accelerated programme either as a UK/rEU graduate or a graduate from the rest of the
657 world (RoW). Average marks (%) for the whole year were weighted by number of credits
658 attached to courses within the Year 1. The width of each violin plot at any one value
659 reflects the frequency of that mark in that group. Boxes within the violins represent the
660 interquartile range, and the round symbols the medians. Numbers in brackets are number
661 of students in a particular group. *** P<0.001.

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663 **Figure 2:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3
664 entry cohorts (2007, 2008 and 2009: 1-3) that completed their first year and (a) had
665 undertaken either A-Levels or Scottish Advanced Highers and Highers; (b) Biology A-
666 Level, Advanced Higher and Higher; (c) Chemistry (A-level and Advanced Higher) and (d)
667 Mathematics (Higher) in relation to whether they had achieved all grade A in these
668 examinations. The width of each violin plot at any one value reflects the frequency of that
669 mark in that group. Boxes within the violins represent the interquartile range, and the round
670 symbols the medians. Numbers in brackets are number of students in a particular group.
671 *** P<0.001, * P<0.05.

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673 **Figure 3:** Violin density plots of average marks in Year 1 of the BVM&S for students in 3
674 entry cohorts (2007, 2008 and 2009: 1-3) in relation to whether the students had (a)
675 attended an independent or state school and (b) attended an independent or state school
676 and achieved a Grade A or less in Advanced Higher Biology. The width of each violin plot
677 at any one value reflects the frequency of that mark in that group. Boxes within the violins
678 represent the interquartile range, and the round symbols the medians. Numbers in
679 brackets are number of students in a particular group. *** P<0.001, * P<0.05.

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681 **Figure 4:** Violin density plots of average marks in Year 1 of the 4- year accelerated
682 BVM&S programme for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) in relation
683 to whether non-UK graduate students had obtained a grade point average (GPA) ≥ 3.4 or
684 <3.4 in their previous degree. The width of each violin plot at any one value reflects the
685 frequency of that mark in that group. Boxes within the violins represent the interquartile
686 range, and the round symbols the medians. Numbers in brackets are number of students
687 in a particular group. * P<0.05.

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704 **Tables**

705

706 **Table 1. Summary of attributes associated with students in the 3 cohorts entering**
707 **the BVM&S Programme in 2007 (Cohort 1), 2008 (Cohort 2) and 2009 (Cohort 3)**
708

	Entry Cohort 1	Entry Cohort 2	Entry Cohort 3
Five year programme entrants	93	98	105
<i>UK/rEU School leavers</i>	72	72	72
<i>RoW School leavers</i>	13	14	19
<i>UK/rEU Graduates</i>	6	9	8
<i>RoW Graduates</i>	2	3	6
Four year graduate entrants	37	49	66
<i>UK/rEU Graduate</i>	13	21	21
<i>Overseas Graduate</i>	24	28	45
Cohort Total	130	147	171
Gender : Female (%)	79.2	78.2	75.4
Age (years)			
Average \pm SD	20.5 \pm 3.7	21 \pm 3.8	21.5 \pm 3.9
\geq 21 (%)	35.4	42.9	49.1
School education			
<i>A-Levels (Non-Scottish)</i>	31	36	53
All A grade (%)	67.7	75.0	73.6
Biology A (%)	93.5	80.6	92.5
Chemistry A (%)	93.5	94.4	98.1
Mathematics A (%)	91.3	88.9	92.9
Physics A (%)	66.7	100.0	62.5
<i>Advanced Highers (Scottish)</i>	49	41	30
All A grade (%)	22.4	41.5	40.0
Biology A (%)	40.4	73.7	55.2
Chemistry A (%)	61.2	65.9	56.7
Mathematics A (%)	40.0	35.7	80.0
Physics A (%)	70.6	80.0	66.7
<i>Highers (Scottish)</i>	49	41	31
All A grade (%)	83.7	70.7	67.7
School type (UK students)			
State	57	50	53
Independent	13	22	19
Gap year between school and university (SFC-funded UK/rEU students)	7	8	15
Domicile (Graduates)			
UK / rEU	21	29	30
USA / Canada	24	33	50
Grade point average (Graduates)			
Average \pm SD	3.59 \pm 0.19	3.51 \pm 0.20	3.47 \pm 0.21
\geq 3.4 (%)	84.0	67.9	59.1
University Grade (Graduates)			
A	13	17	31
B	21	25	22
C	11	20	28
UK Degree qualification			
1 st	6	5	3
2i	14	25	26

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710 **Table 2a : Summary of the end of BVM&S Year 1 performance mark (P value,**
711 **average \pm SD)**
712

Variable	P value	Group	
Programme		5 Year	4 year
Overall	<0.001	63.5 \pm 9.4	60.1 \pm 9.1
<i>UK/rEU SFC School leavers</i>		63.7 \pm 9.4	-
<i>RoW School leavers</i>	0.879	62.9 \pm 10.3	-
<i>UK/rEU/RoW Graduates</i>		63.1 \pm 7.9	-
<i>UK/rEU Graduates</i>	0.975	-	59.9 \pm 8.7
<i>RoW Graduates</i>		-	60.1 \pm 9.4
A-Levels (Non-Scottish)		Yes	No
<i>All A grade</i>	<0.001	66.8 \pm 8.1	59.7 \pm 11.7
<i>UK</i>	0.055	67.0 \pm 7.1	61.9 \pm 12.2
<i>RoW</i>		66.3 \pm 10.8	53.0 \pm 6.8
<i>Biology A</i>	<0.001	66.5 \pm 8.0	50.3 \pm 11.2
<i>Chemistry A</i>	0.622	64.9 \pm 9.8	63.0 \pm 5.2
<i>Mathematics A</i>	0.795	64.3 \pm 10.2	65.0 \pm 7.1
<i>Physics A</i>	0.409	66.3 \pm 10.9	65.2 \pm 8.6
Advanced Highers (Scottish)		Yes	No
<i>All A grade</i>	<0.001	66.9 \pm 8.3	59.3 \pm 8.8
<i>Biology</i>	<0.001	65.0 \pm 8.3	58.1 \pm 9.6
<i>Chemistry</i>	<0.001	64.7 \pm 8.9	57.2 \pm 8.2
<i>Mathematics</i>	0.091	67.1 \pm 10.8	60.6 \pm 8.8
<i>Physics</i>	0.847	62.3 \pm 8.7	63.1 \pm 4.6
Highers (Scottish)		Yes	No
<i>All A grade</i>	<0.001	63.7 \pm 8.7	56.8 \pm 9.2
<i>Biology A</i>	<0.001	62.8 \pm 8.9	49.4 \pm 6.6
<i>Chemistry A</i>	0.359	62.1 \pm 9.4	57.0 \pm 0.0
<i>Mathematics A</i>	0.038	62.8 \pm 9.4	58.1 \pm 9.0
<i>Physics A</i>	0.116	62.5 \pm 9.7	57.3 \pm 7.3
School type		Independent	State
<i>Overall</i>	0.028	65.8 \pm 9.9	62.9 \pm 9.2
<i>Advanced Highers Biology : A</i>	0.001	68.1 \pm 9.0	64.3 \pm 8.0
<i>Advanced Highers Biology : < A</i>		48.0 \pm 9.5	59.6 \pm 8.8
<i>Highers : All A</i>	0.113	66.1 \pm 9.8	63.3 \pm 8.5
<i>Highers : At least 1 < A</i>		53.0 \pm 14.9	57.7 \pm 7.4

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721 **Table 2b : Summary of the end of BVM&S Year 1 performance mark (P value,**
 722 **average \pm SD)**
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Variable	P value	Group		
Degree mark (UK Graduates)		1 st	2i	
5 year programme	- ^a	70.0 \pm 2.8	62.0 \pm 9.2	
4 year programme	0.057	65.5 \pm 6.3	59.5 \pm 8.7	
GPA (Non UK graduates)		\geq 3.4	< 3.4	
5 year programme	0.964	64.6 \pm 8.0	62.8 \pm 5.8	
4 year programme	0.015	62.1 \pm 10.2	55.8 \pm 6.3	
Gender		Female	Male	
5 year programme	0.348	63.8 \pm 8.8	62.5 \pm 10.9	
4 year programme	0.784	60.2 \pm 9.4	59.5 \pm 8.0	
Age at start of degree	0.003	<21 years	\geq 21 years	
		63.6 \pm 9.5	60.6 \pm 9.1	
Gap year taken (UK/rEU school)	0.760	Yes	No	
		63.2 \pm 7.6	63.7 \pm 9.7	
Domicile (Graduates)		UK/rEU	USA/Canada	
5 year programme	0.244	61.4 \pm 7.9	64.4 \pm 8.0	
4 year programme	0.551	60.7 \pm 8.5	59.8 \pm 9.6	
Where Degree obtained		UK	rEU/RoW	
5 year programme	0.132	61.1 \pm 8.5	64.8 \pm 7.5	
4 year programme	0.385	61.1 \pm 8.4	59.5 \pm 9.5	
University Grade		A	B	C
5 year programme	0.053	67.1 \pm 4.8	59.9 \pm 8.5	61.7 \pm 8.5
4 year programme	0.842	60.5 \pm 11.2	60.4 \pm 7.9	59.0 \pm 8.1

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725 ^a Only 2 entrants on 5 year programme with a 1st

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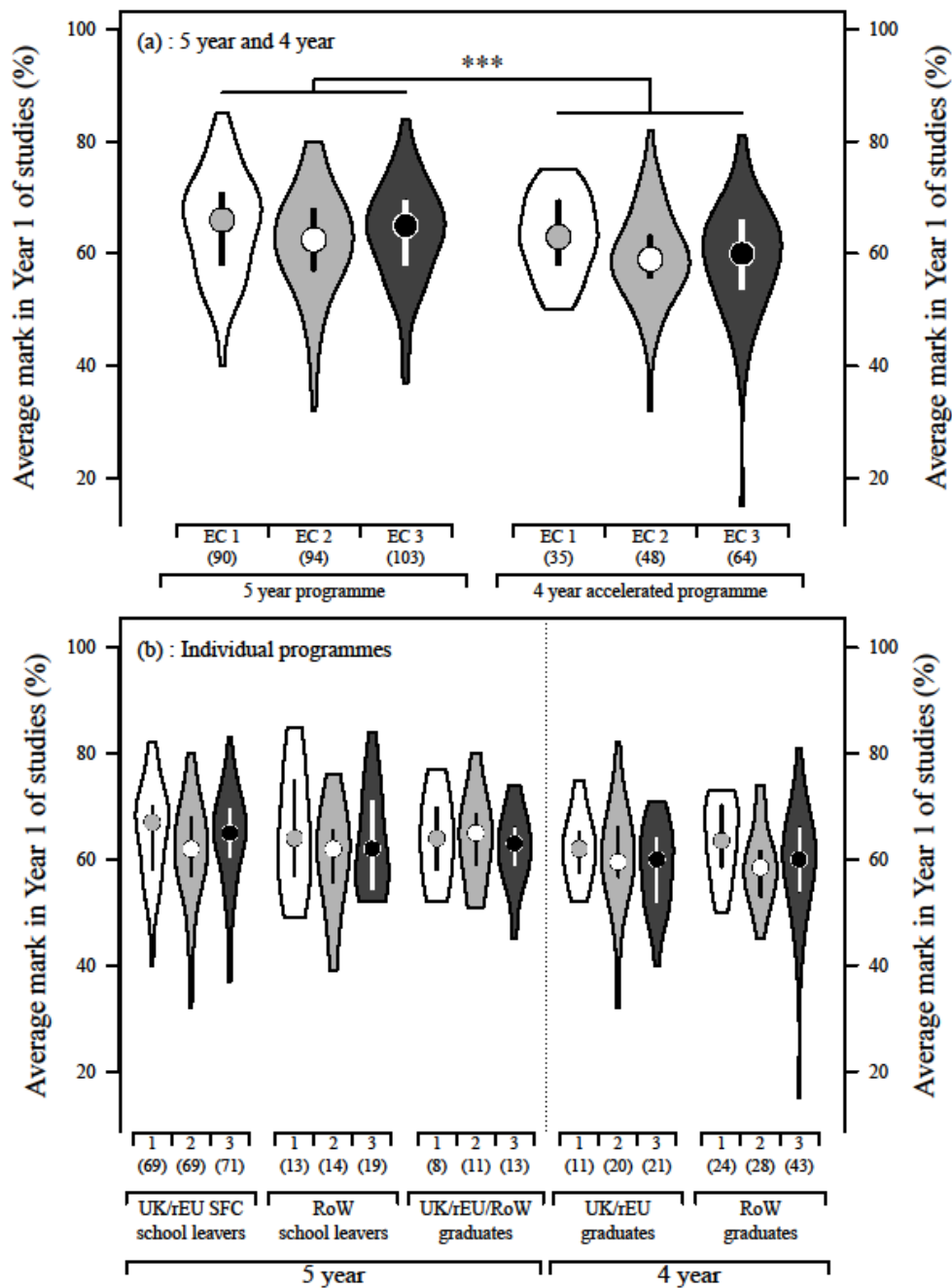


Figure 1: Violin density plots of average marks in Year 1 of the BVM&S for students in 3 entry cohorts (2007, 2008 and 2009: EC 1-3) that completed their first year and had started (a) either the 5- year or 4- year accelerated graduate entry programme; (b) had started the 5- year programme as a school-leaver, either UK/rest of EU (rEU) Scottish Funding Council-funded (SFC) or rest of the world (RoW)); or had graduated either from a UK, rest of the EU or rest of the world university (UK/rEU/RoW); or had started the 4- year accelerated programme either as a UK/rEU graduate or a graduate from the rest of the world (RoW). Average marks (%) for the whole year were weighted by number of credits attached to courses within the Year 1. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. *** P < 0.001.

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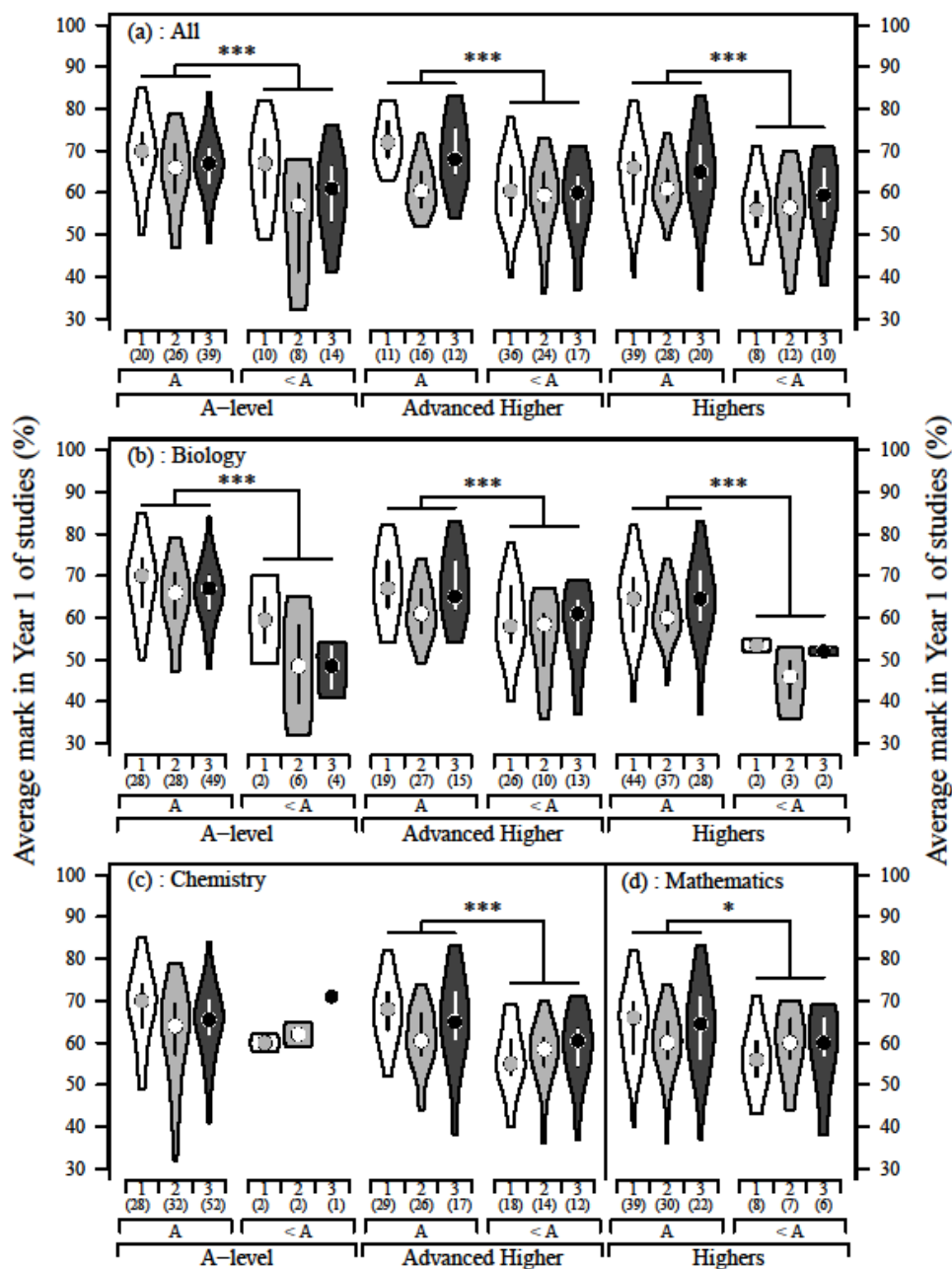


Figure 2: Violin density plots of average marks in Year 1 of the BVM&S for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) that completed their first year and (a) had undertaken either A-Levels or Scottish Advanced Highers and Highers; (b) Biology A-Level, Advanced Higher and Higher; (c) Chemistry (A-level and Advanced Higher) and (d) Mathematics (Higher) in relation to whether they had achieved all grade A in these examinations. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. *** P<0.001, * P<0.05.

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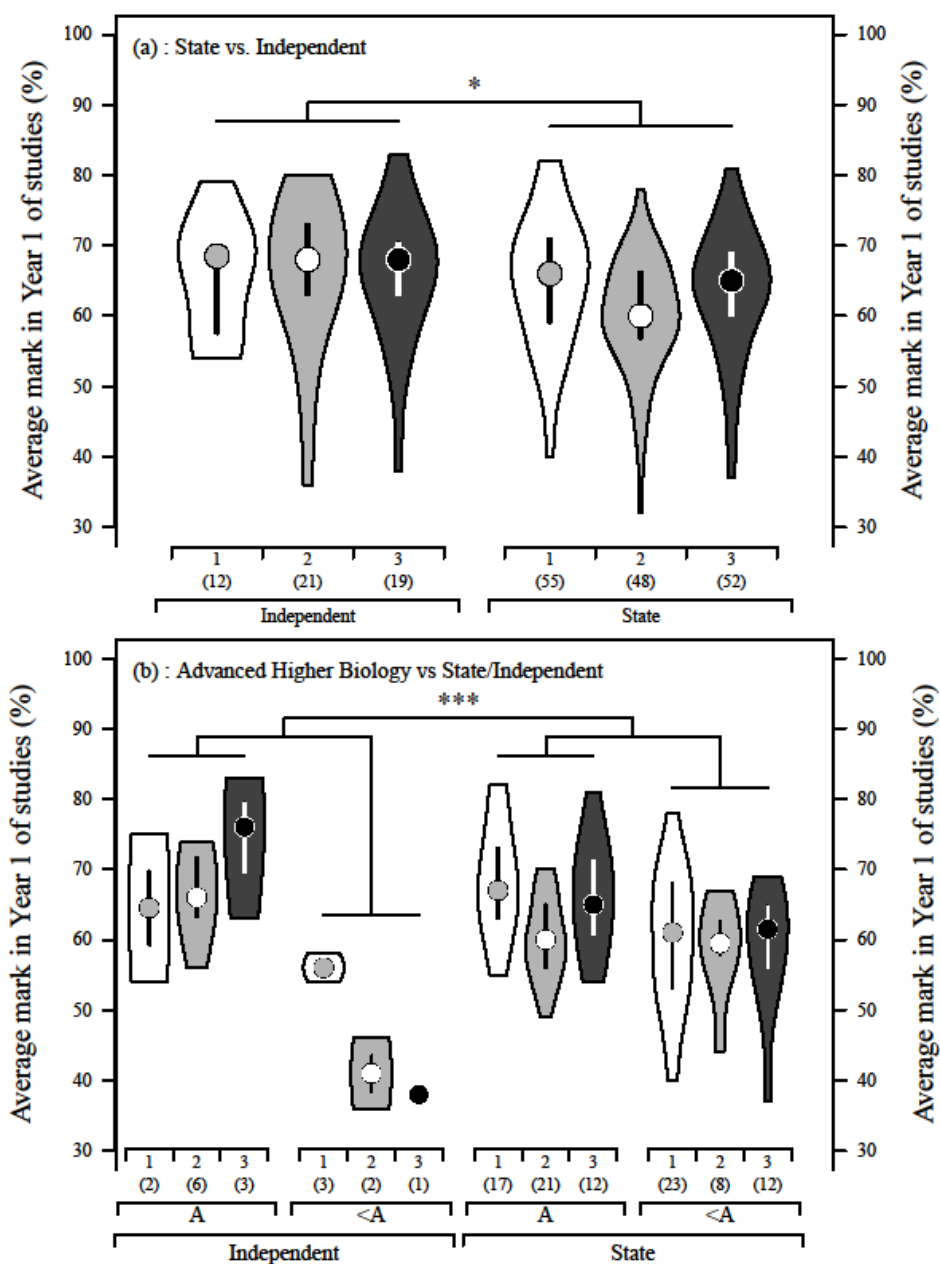


Figure 3: Violin density plots of average marks in Year 1 of the BVM&S for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) in relation to whether the students had (a) attended an independent or state school and (b) attended an independent or state school and achieved a Grade A or less in Advanced Higher Biology. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. *** $P < 0.001$, * $P < 0.05$.

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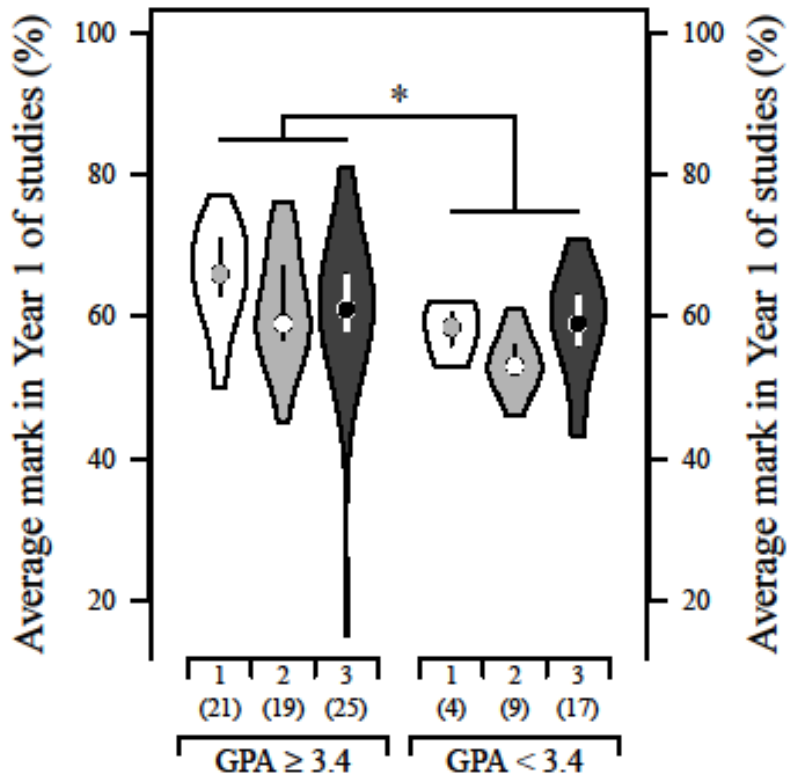


Figure 4: Violin density plots of average marks in Year 1 of the 4- year accelerated BVM&S programme for students in 3 entry cohorts (2007, 2008 and 2009: 1-3) in relation to whether non-UK graduate students had obtained a grade point average (GPA) ≥ 3.4 or < 3.4 in their previous degree. The width of each violin plot at any one value reflects the frequency of that mark in that group. Boxes within the violins represent the interquartile range, and the round symbols the medians. Numbers in brackets are number of students in a particular group. * $P < 0.05$.