Eur J Clin Pharmacol (2013) 69:1331–1334
DOI 10.1007/s00228-012-1461-9

PHARMACOEPIDEMIOLOGY AND PRESCRIPTION

The specialty clinical pharmacology needs to be examined separately to guarantee a sufficient level of knowledge in medical students

Susanna M. Wallerstedt · Mattias Wallerstedt · Sven Wallerstedt

Received: 26 September 2012 / Accepted: 26 November 2012 / Published online: 19 December 2012

Abstract
Purpose In medical schools small specialties like clinical pharmacology may be integrated in courses covering larger specialties and examined concomitantly. The results of a pilot study suggested that this approach would have negative consequences on the knowledge gained in clinical pharmacology with integration of this speciality in the course of internal medicine and concomitant examination. The aim of the present study was to assess in more detail whether students' presumed tendency to study selectively influences approval (the pass mark), a surrogate marker of the knowledge gained.
Methods A written examination for the integrated course in clinical pharmacology and internal medicine in Gothenburg, Sweden, was specifically designed in 2008 to evaluate the research question. The examination consisted of 50 short answer questions, of which five focused on clinical pharmacology (maximum score 10) and 45 were on internal medicine (maximum score 90). The cut-off level for approval (pass mark) was 60 %.
Results Of the 81 students who wrote the examination, 73 (90.1 %) passed the examination as a whole. When the questions in clinical pharmacology were assessed separately, 62 (76.5 %) students passed the cut-off level of 60 %; the corresponding proportion of students achieving the cut-off level for questions on internal medicine was 90.1 %. There was a significant correlation between the results of the two specialties ($p<0.001$), but the questions on clinical pharmacology generated lower scores ($p<0.001$). The correlation coefficient between the results of two randomly chosen questions for clinical pharmacology was greater than that of two randomly chosen questions in internal medicine ($p<0.001$).
Conclusions Our results confirm that a small specialty like clinical pharmacology may need to be examined separately in order to guarantee a sufficient level of knowledge among students.

Keywords Clinical pharmacology · Device approval · Educational measurement · Internal medicine

S. M. Wallerstedt (✉)
Department of Clinical Pharmacology, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden
e-mail: susanna.wallerstedt@pharm.gu.se

M. Wallerstedt
Department of Mathematical Sciences, Chalmers University of Technology, Gothenburg, Sweden

S. Wallerstedt
Department of Internal Medicine, Sahlgrenska Academy, University of Gothenburg, Gothenburg, Sweden

Introduction

Clinical pharmacology is an important medical specialty which aims to improve patient care, directly or indirectly, by developing better drugs and promoting the safer and more effective use of drugs [1]. Although the field of clinical pharmacology is broad and general, the specialty area may be considered quite small since there are relatively few clinical pharmacologists. In Swedish medical schools, small specialties, like clinical pharmacology, are often integrated in larger courses. As a consequence, they may also be examined concomitantly. One function of an examination is to ensure that students have learnt the essential part of the course. However, it is unknown whether examinations covering several specialties can guarantee that medical students have acquired sufficient knowledge in each specialty area. Indeed, this may not be the case since it has been shown that

students in general adapt their way of learning to their conception of what is required of them [2]. This has also been shown for medical students who tend to focus their learning on those subjects which will enable them to pass the examination [3]. To do this the the student may actively identify the hidden and the informal curriculum [4], which may influence the learning process [5], or he/she may ignore those areas of the course that are assumed to have limited significance for the overall assessment, regardless of their importance.

Written examinations consisting of short answer questions (SAQ) represent one type of examination. In order to design a suitable and appropriate SAQ examination, it is important that the person making the examination is aware of the advantages and disadvantages of SAQ, which have been thoroughly discussed [6] and evaluated in relation to examinations comprising modified essay questions [7]. It must also be stressed that in specialties with considerable knowledge content, it is almost impossible to cover all items in an examination. An example of such a specialty is internal medicine. In the course covering internal medicine in Gothenburg, the possibility to examine all items decreased when the specialty clinical pharmacology was integrated and examined concomitantly.

In 2006, we performed a pilot study on the examination for the integrated course in internal medicine and clinical pharmacology. The results of the participating 71 students were analysed in order to evaluate (1) how the approval (pass) decision was related to students' reported tendency to study selectively and (2) whether all parts of the course need to be examined. The examination was made up by the established teacher board and consisted of 48 questions, generating a maximum score of 80. Questions on the specialty clinical pharmacology represented 4.5 score points (5.6 %). The students were not informed beforehand about the study, and their identities were discarded before their results were registered. The teacher board set the arbitrary approval level (pass mark) to 65 % correct answers. Three students (4.2 %) scored at most 44 (55 % of maximum) and thus failed the examination, whereas the remainder scored at least 55 (69 % of maximum). In terms of the questions in clinical pharmacology, when analysed separately, as many as 22 students (31 %) did not reach the approval level. When the approval limit was lowered to 2.5 score points (56 % of maximum), a significant number of students still failed (n= 7; 9.9 %).

The results from the pilot study encouraged us to perform the study reported here. The aim of this study was to investigate whether the findings of the pilot study were reproducible and whether students' hypothetical tendency to study selectively influences the approval decision regarding two diverse specialty areas, i.e. if the knowledge gained in a small specialty area like clinical pharmacology would be at risk when examined concomitantly within the framework of a large specialty area like internal medicine.

Material and methods

The study was carried out on students following the integrated course in internal medicine and clinical pharmacology ending in May 2008 in Gothenburg, Sweden, which had the same curriculum as the course ending in January 2006. At the end of this course, 81 students underwent a written examination, which was specifically composed by the course leader (SW) to evaluate the research question. The examination consisted of 50 SAQ based on patient cases with a mix of questions on the two specialty areas. The questions were chosen from questions provided by those giving the course, who had not been informed beforehand that their questions were to be used to compare results on different parts of the examination. The students' responses were matched against an agreed-upon response plan. The maximum score was 100, and the cut-off level for approval (pass mark) was set to 60 % of the maximum by the teaching board after participating in the marking procedure. Forty-five questions focused on internal medicine (maximum score: 90), and five questions were on clinical pharmacology (maximum score: 10); the latter number of questions was deliberately increased compared with the pilot study to improve the basis for conclusions on the influence of concomitant examination of different specialty areas on the level of knowledge gained.

As in our previous study, the students were not informed beforehand about the study, which could have ethical implications, but the students' identities were removed from the dataset before their results on the examination questions were registered for the study. Thus, the rules and regulations for an ethical vetting were not applicable.

Fisher's test for the pair-wise comparisons and the Spearman rank correlation test were used to statistically analyse the results. In order to evaluate whether the students studied selectively, we used variance test according to Snedecor. This method allowed us to elucidate if the standard deviations of the mean results differed between the questions in the two specialty areas.

Results

The students' results in the integrated examination of clinical pharmacology and internal medicine are presented in Table 1. A total of 73 (90.1 %) of the 81 students passed the examination (60.5–89.5 score points) and eight (9.9 %) failed (49.5–59.5 score points). When a cut-off level of 60 % was applied for questions in clinical pharmacology

Table 1 Distribution of results with respect to score intervals for 81 medical students participating in the examination for the integrated course of internal medicine and clinical pharmacology

Total	Score points	30–39.5	40–49.5	50–59.5	60–69.5	70–79.5	80–89.5	90–100
	Students (*n*)	0	1	7	25	40	8	0
Internal medicine	Score points	<36	36–44.5	45–53.5	54–62.5	63–71.5	72–80.5	81–90
	Students (*n*)	0	0	8	22	41	10	0
Clinical pharmacology	Score points	3–3.5	4–4.5	5–5.5-	6–6.5	7–7.5	8–8.5	9–10
	Students (*n*)	2	6	11	21	29	10	2

separately (6 score points), 62 (76.5 %) students passed the examination (6.0–9.0 score points) and 19 (23.5 %) failed (3.0–5.5 score points). The correlation coefficient between these two types of question was 0.40 ($p<0.001$).

The questions in clinical pharmacology generated lower scores per question than the questions focusing on other areas of internal medicine (1.31 vs. 1.43; $p<0.001$). Snedecor's variance test showed a significant difference between the standard deviations of the mean results from the two specialty areas ($p<0.001$), thus demonstrating that the correlation coefficient between the results of two randomly chosen questions in clinical pharmacology was greater than the corresponding figures between the results of questions in internal medicine.

Discussion

The results of our study indicate that a small specialty area as clinical pharmacology, when integrated in a large specialty area as internal medicine, may be overlooked by the students when the two specialties are tested in the same examination. Indeed, our results confirm the deduction from our pilot study that medical students, as a consequence of focusing their learning on that which will enable them to pass the examination [3], have a tendency to study selectively. Although significant, the results of the present study do not differ as much as those in the pilot study, possibly due to an almost twofold higher proportion of questions on the small specialty area or a lowered cut-off level for approval (pass mark) from 65 to 60 % correct answers.

Our results are interesting since written examinations often play an important role in determining whether students pass of fail a course—that is, it is an important procedure which assesses whether the student has achieved a sufficient level of knowledge. Medical students are generally high achievers, and the most important function of a written examination in medical school therefore seems to be to identify students that clearly diverge. This implies that the approval decision may be more important than the grading process, although Cunningham states: "the mastery of an objective is better described as continuous than categorical", and therefore, "to select an arbitrary point on a continuum and declare that those above that point have reached mastery while those below have not, is nonsensical" [6].

Interestingly, questions in clinical pharmacology generated fewer points per question than the questions in internal medicine, although there was a significant correlation between the results of the two specialty areas. Thus, it could be presumed that the questions in clinical pharmacology were more difficult, which in turn could explain the increased risk of failing. However, the results from the variance analysis showed that students who failed in one question more often failed in another one, and those who gave a correct answer also more often gave another correct answer, if the questions concerned clinical pharmacology as opposed to internal medicine.

It must also be pointed out that clinical pharmacology is a specialty that clearly diverges from internal medicine, as it is a translational discipline in terms of the basic tools of human pharmacology (e.g. receptor pharmacology) and applied pharmacology (e.g. pharmacokinetics) and how they are used in drug discovery and development and in solving practical therapeutic problems in individuals and populations [8]. Internal medicine, on the other hand, consists of several different subspecialties, such as gastroenterology, endocrinology and haematology. Thus, if students choose to study selectively, the choice of areas to ignore could be expected to be complex. The specialty clinical pharmacology clearly diverges from the various specialties in internal medicine, and the student may find this specialty difficult to grasp and apply to clinical problems. Therefore, it seems probable that there may be a significant number of students who prefer to ignore this small specialty area in an integrated examination.

A broader interpretation of our study results may be that students choose to study selectively by studying large areas in favour of small areas, especially if the students believe that a small area will be represented by a proportionally equally small part of the examination. In this study, the proportion of questions on clinical pharmacology was increased from the usual level of 5 % to 10 % of the total marks. The students were not informed about this, and thus they could not anticipate the impact of weak knowledge in

this small specialty area on the approval (pass mark) and that the choice to study selectively would be a high-risk strategy. The interpretation that students would choose to study selectively is in line with earlier reports [3], and a potential consequence of the evident selective learning strategy of the students could be that it may be preferable to examine important small fields separately. However, we cannot rule out that the results are specific for the two specialty areas included in our study, and further research would be of value.

Although only 81 students were included in our study, it seems reasonable to generalize from these results; no one was excluded from the analysis, and the results were highly significant although the number of students was low. Furthermore, it is important to note that the present study covers only the short-time effects of an examination. Thus, we cannot exclude the possibility that the students realize later on that they need knowledge in clinical pharmacology in their future professional careers and that they therefore compensate for weak results in the integrated examination in future learning. Another limitation of our study is that no formal standard setting procedure, such as the Angoff method, was applied to the question material. Thus, we cannot determine if the clinical pharmacology questions were more difficult than the internal medicine ones. This uncertainty can be addressed in future studies.

Conclusion

Even if different medical specialty areas, like clinical pharmacology and internal medicine, can be integrated in the same course, it seems necessary to examine the areas separately if the goal is to assess the students' knowledge in the areas of interest. Medical students would appear to study selectively for a specific examination.

Acknowledgements We thank Anders Odén, professor in Biostatistics at Chalmers University, for valuable statistical support and constructive criticism. The study was supported by faculty grants.

Conflict of interest None.

References

1. Orme M, Sjöqvist F (eds) (2010) Clinical pharmacology in research, teaching and health care: considerations by IUPHAR, the International Union of Basic and Clinical Pharmacology. Basic Clin Pharmacol Toxicol 107:531–559
2. Marton F, Säljö R (1976) On qualitative differences in learning—II outcome as a function of the learner's conception of the task. Br J Educ Psychol 46:115–127
3. Newble DI, Jaeger K (1983) The effect of assessments and examinations on the learning of medical students. Med Educ 17:165–171
4. Ozolins I, Hall H, Peterson R (2008) The student voice: recognising the hidden and informal curriculum in medicine. Med Teach 30:606–611
5. Zhang J, Peterson RF, Ozolins IZ (2011) Student approaches for learning in medicine: what does it tell us about the informal curriculum? BMC Med Educ 11:87
6. Cunningham GK (1998) Assessment in the classroom: constructing and interpreting tests. Falmer Press, London
7. Wallerstedt S, Erickson G, Wallerstedt SM (2012) Short answer questions or modified essay questions—more than a technical issue. Int J Clin Med 3:28–30
8. Aronson JK (2010) A manifesto for clinical pharmacology from principles to practice. Br J Clin Pharmacol 70:3–13