

# BASIC SCIENCES AS A SOURCE OF SUCCESS IN TEACHING MIDWIVES TO PROVIDE SPECIALISED CARE – A SINGLE-CENTRE STUDY

## NAUKI PODSTAWOWE JAKO ŹRÓDŁO SUKCESU W KSZTAŁCENIU POŁOŻNYCH Z ZAKRESU OPIEKI SPECJALISTYCZNEJ – BADANIE JEDNOŚRODKOWE

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### ABSTRACT

**Aim.** Assessment of the impact of admission criteria and students' educational achievements in basic sciences on learning outcomes with regard to specialised care among Midwifery students.

**Material and methods.** Admission data and learning outcomes of 622 Midwifery students who graduated from a full-time Bachelor's degree programme between 2007-08 and 2014-15. Mean age of  $19.5 \pm 1.86$  years; 92% of the study participants passed a "new matura exam"; 33% of all students graduated from a secondary school in Warsaw. Statistical methods: multiple stepwise regression model and analysis of covariance. Calculated in STATISTICA version 12.5; assumed alpha of 0.05.

**Results.** The best-fitted regression model considered five independent variables ( $F = 60.846$ ;  $P < 0.001$ ;  $R_{2\text{adjusted}} = 0.351$ ). None of the socio-demographic factors was included in the regression model. Rank scores calculated during the admission process for the additional subject ( $\beta_{\text{stand.}} = 0.298$ ) was the strongest predictor of students' achievements regarding specialised care, followed by exam scores for the "Anatomy" ( $\beta_{\text{stand.}} = 0.253$ ) and "Parasitology" ( $\beta_{\text{stand.}} = 0.214$ ) courses. Analysis of covariance demonstrated a lack of significant differences in mean scores regarding specialised care between students who had passed biology in the matura exam and those who had chosen another additional subject ( $F = 0.005$ ;  $P = 0.942$ ).

**Conclusions.** Good preparation of students in basic sciences is crucial for their future educational achievements as far as courses associated with specialised care are concerned. Caring about high quality of teaching midwives in the area of biological sciences is essential for providing efficient professional education in this major.

KEYWORDS: biological science disciplines, obstetrics, educational measurement, clinical competence.

### STRESZCZENIE

**Cel.** Ocena wpływu kryteriów kwalifikacji na studia oraz osiągnięć edukacyjnych studentów z obszaru nauk podstawowych na uzyskane wyniki kształcenia w zakresie opieki specjalistycznej w grupie studentów położnictwa.

**Materiał i metody.** Dane kwalifikacji na studia oraz wyniki kształcenia 622 studentów kierunku położnictwo, którzy ukończyli studia stacjonarne pierwszego stopnia w okresie między rokiem 2007/08 a 2014/15. Średnia wieku  $19,5 \pm 1,86$  lat; 92% badanych zdało „nową maturę”; 33% studiujących ukończyło szkołę średnią w Warszawie. Metody statystyczne: model krokowej regresji wielorakiej oraz analiza kowariancji. Obliczenia w programie STATISTICA wersja 12.5; zakładana wartość  $\alpha$  na poziomie 0,05.

**Wyniki.** Najlepiej dopasowany model regresji uwzględnił pięć zmiennych niezależnych ( $F = 60,846$ ;  $p < 0,001$ ;  $R^2_{\text{skoryg.}} = 0,351$ ). Żaden z ocenianych czynników socjo-demograficznych nie został włączony do modelu regresji. Najsilniejszym predyktorem osiągnięć studentów z zakresu opieki specjalistycznej była punktacja rankingowa, wyliczona podczas kwalifikacji na studia dla przedmiotu dodatkowego ( $\beta_{\text{stand.}} = 0,298$ ), a następnie oceny egzaminacyjne z „Anatomii” ( $\beta_{\text{stand.}} = 0,253$ ) i „Parazytologii” ( $\beta_{\text{stand.}} = 0,214$ ). Analiza kowariancji wskazuje na brak istotnych różnic między średnimi ocenami z zakresu opieki specjalistycznej w grupie studentów zdających biologię na egzaminie maturalnym a tymi, którzy wybrali inny przedmiot dodatkowy ( $F = 0,005$ ;  $p = 0,942$ ).

**Wnioski.** Dobre przygotowanie studentów z zakresu nauk podstawowych ma znaczący wpływ na ich późniejsze osiągnięcia edukacyjne w grupie przedmiotów związanych z opieką specjalistyczną. Dbanie o wysoką jakość kształcenia położnych z obszaru nauk biologicznych jest niezbędne dla zapewnienia efektywnej edukacji zawodowej na tym kierunku studiów.

SŁOWA KLUCZOWE: nauki biologiczne, położnictwo, ocena wiadomości, kompetencje kliniczne.

### Introduction

A Midwifery Curriculum for Bachelor students at Medical University of Warsaw (MUW) covers all principles defined in standards relating to the major studies and

regulated by the applicable Regulation of the Minister of Science and Higher Education [1]. The Bachelor's degree curriculum includes a total of 40 courses (2420 hours), 20 of which end up with a final test equivalent to an

exam. According to the ministerial standards, all educational outcomes have been divided into four categories where Group A comprises basic science courses and Group D comprises courses associated with training in specialised care [1].

It should be assumed that effective learning during the first semesters (Group A) will make students well prepared for learning at further stages of vocational training in specialised care (Group D). Moreover, it may be expected that the level of preparation of students at the very beginning of the programme also has a great impact on vocational training of midwives. Therefore, an appropriate range of initial competence that needs to be properly assessed during the admission process is an important prerequisite of future educational achievements of a student.

Each medical university handles recruitment to a Bachelor's degree programme in Midwifery according to their own principles. They usually focus on one or two criteria based on grades obtained for particular subjects at the matura exam. A review of the admission criteria that are currently in force at Polish universities (figures for the academic year 2016-17) demonstrated that results for the biology matura exam were compulsorily required by four universities and the remaining universities gave the opportunity to choose an additional subject (biology included). Due to the lack of uniform rules for performing the admission procedure for Midwifery programmes in Poland, there are difficulties in assessing efficiency of the admission rules that would be nationwide. However, currently published data on admission to Nursing programmes suggest that certain single-centre study findings may also be of value for other academic centres [2-4].

## Aim

Assessment of the impact of admission criteria and students' educational achievements in basic science on learning outcomes with regard to specialised care among Bachelor's degree students in Midwifery.

## Material and methods

A retrospective study involved data concerning a total of 622 Midwifery students who had graduated from a full-time Bachelor's degree programme at the Faculty of Health Science between 2007-08 and 2014-15. Data concerning socio-demographic factors such as age, city of secondary school graduation, and type of the matura exam were collected on the basis of information provided in the application forms filled in by candidates. Mean age of students at the beginning of studies amounted to  $19.5 \pm 1.86$  years (median: 19.0; CV: 9.5%). Over 92% of the study participants passed the so called

“new matura exam”. One third of all students graduated from a secondary school in Warsaw. See **Table 1** for detailed characteristics of the study group of students.

**Table 1.** Characteristics of group of students who graduated from a full-time Bachelor's degree programme at Medical University of Warsaw between 2007-08 and 2014-15

Admission year	N	Mean age $\pm$ SD	Mature exam		City of secondary school graduation	
			new	old	Warsaw	other
2007/08	50	19.4 $\pm$ 1.60	35	15	19	31
2008/09	97	19.6 $\pm$ 2.60	87	10	41	56
2009/10	74	19.1 $\pm$ 0.46	70	4	28	46
2010/11	80	19.4 $\pm$ 1.76	77	3	30	50
2011/12	87	19.6 $\pm$ 2.15	81	6	37	50
2012/13	83	19.6 $\pm$ 1.88	80	3	30	53
2013/14	77	19.2 $\pm$ 0.75	75	2	20	57
2014/15	74	19.4 $\pm$ 1.95	72	2	25	49
Total	622	19.5 $\pm$ 1.86	577	45	230	392

SD – standard deviation

Source: author's own analysis

The results of admission procedure for a Bachelor's degree programme were taken from the University Admission System and comprised rank scores estimated for the additional subject, taking into consideration whether it was biology or another subject. Data on grades obtained for courses in basic science that ended up with a final test equivalent to an exam were also collected for each student. Moreover, grade point average achieved by students for exams for courses in specialised care were also calculated. The above data were collected in the Central Database of Students designed to support administrative management of students and mode of studies. See **Table 2** for a detailed list of courses.

**Table 2.** List of particular subjects included in Groups A and D according to teaching standards for Bachelor's degree programme in Midwifery

Group of learning outcomes	Subject	Exam
Basic sciences	Anatomy	•
	Physiology	•
	Pathology	
	Embryology and Genetics	
	Biochemistry and Biophysics	
	Microbiology	•
	Parasitology	•
	Pharmacology	•
	Radiology	

	Obstetric training and Care in birth assistance	•
	Obstetrics and Maternity Care	•
	Gynecology and Gynecological Care	•
	Neonatology and Clinical Consumables	•
Sciences in the field of specialist care	Pediatrics and Pediatric Nursing	•
	Internal medicine	•
	Surgery	•
	Psychiatry	•
	Anesthesiology	•
	Rehabilitation in obstetrics, neonatology and gynecology	•
	Basics emergency medical services	•

Source: author's own analysis

In line with the position of the Ethical Review Board, MUW, the approval of the Board is not necessary to conduct retrospective studies, surveys, and other non-invasive activities.\* The present authors obtained the consent of the Local Controller of the Personal Data for processing of personal data of MUW students.

The analysis of multiple linear regression model with forward stepwise introduction of independent variables was used to assess the impact of educational achievements of students in basic sciences on learning outcomes in specialised care. The following predictors were assessed in the regression model: three socio-demographic factors (age, city of secondary school graduation, and type of the matura exam), a rank score for the additional subject obtained in the admission process, and students' grades for five exams for courses in basic sciences (Anatomy, Physiology, Microbiology, Parasitology, and Pharmacology). The grade point average obtained by students for all exam courses in specialised care constituted a dependant (outcome) variable.

The regression model was adjusted to the empirical data using the method of the least squares. The *a priori* threshold value of F-test statistics was established at 1.0 and tolerance was set at over 0.1 in order to assess the significance of variables. As part of the testing of assumptions for the multiple linear regression model, the level of correlation of predictors was assessed using

\* Detailed information and model documents of the Ethical Review Board of Medical University of Warsaw are available at: <https://komisja-bioetyczna.wum.edu.pl/content/szczegółowe-informacje-oraz-wzory-dokumentów> (date of access: December 16th, 2015).

the multicollinearity test (VIF, Variance Inflation Factor), assuming the impassable value at 10 [5]. An analysis of residuals was also performed by testing homoscedasticity (the White test), normal distribution (Shapiro-Wilk test), and level of residual correlation (Durbin-Watson test) [6]. The regression model thus obtained was tested for the functional misspecification and stability of the model (the RESET Ramsey and Chow tests). The direction and force of significant correlations were interpreted by identifying standardised  $\beta$  regression coefficients. Values of the adjusted  $R^2$  statistics were established to evaluate the level of variance clarification for each regression model.

The analysis of covariance (ANCOVA) was conducted to assess potential differences in students' achievements in specialised care by a chosen additional subject in the matura exam (biology or another additional subject). A rank score based on the matura results in biology or other additional subjects was used as a covariate.

STATISTICA statistical package version 12.5 with an additional "Set PLUS" module (StatSoft, Inc.) licensed to MUW was used in the analysis. The *a priori* significance level was established for all analyses at  $\alpha = 0.05$ .

## Results

The stepwise regression analysis produced the best predictive model ( $F = 60.846$ ;  $P < 0.0001$ ; standard error of estimation = 0.270;  $R^2_{\text{adjusted}} = 0.351$ ). The regression model tested in the present study was correct and stable and the analysis of residuals and redundancy demonstrated that the assumptions for this method had been met. All results referring to the diagnostics of the regression function tested here were attached as an additional data file (Supplementary data).

The best suited regression model included five independent variables. None of the socio-demographic factors studied here was included in the regression model and only "Physiology" out of all examination subjects in basic sciences turned out to be an unimportant predictor. Rank scores calculated during the admission process for the additional subject ( $\beta_{\text{stand.}} = 0.298$ ) had the strongest impact on students' educational achievements in specialised care. Grades for "Anatomy" ( $\beta_{\text{stand.}} = 0.253$ ) were the second strongest predictor of educational success, followed by those for "Parasitology" ( $\beta_{\text{stand.}} = 0.214$ ). See **Table 3** for a detailed list of results of the stepwise regression analysis.

**Table 3.** Stepwise regression model of a group of students who graduated from a full-time Bachelor's degree programme at Medical University of Warsaw between 2007-08 and 2014-15. Assessment of regression function parameters for outcome variable: grade point average for examination courses in specialised care

Independent variable	b	$\beta_{stand.}$	95% CI		t-statistic	P-value
			low	upper		
Intercept	2.035	----	----	----	20.496	< 0.001
Anatomy	0.123	0.253	0.183	0.322	7.151	< 0.001
Microbiology	0.094	0.176	0.103	0.248	4.760	< 0.001
Parasitology	0.110	0.214	0.145	0.284	6.024	< 0.001
Pharmacology	0.045	0.098	0.028	0.167	2.771	0.006
Rank score for the additional subject	0.005	0.298	0.229	0.368	8.464	< 0.001

95% CI – 95% confidence interval, b – unstandardized regression coefficient,  $\beta_{stand.}$  – standardized regression coefficient

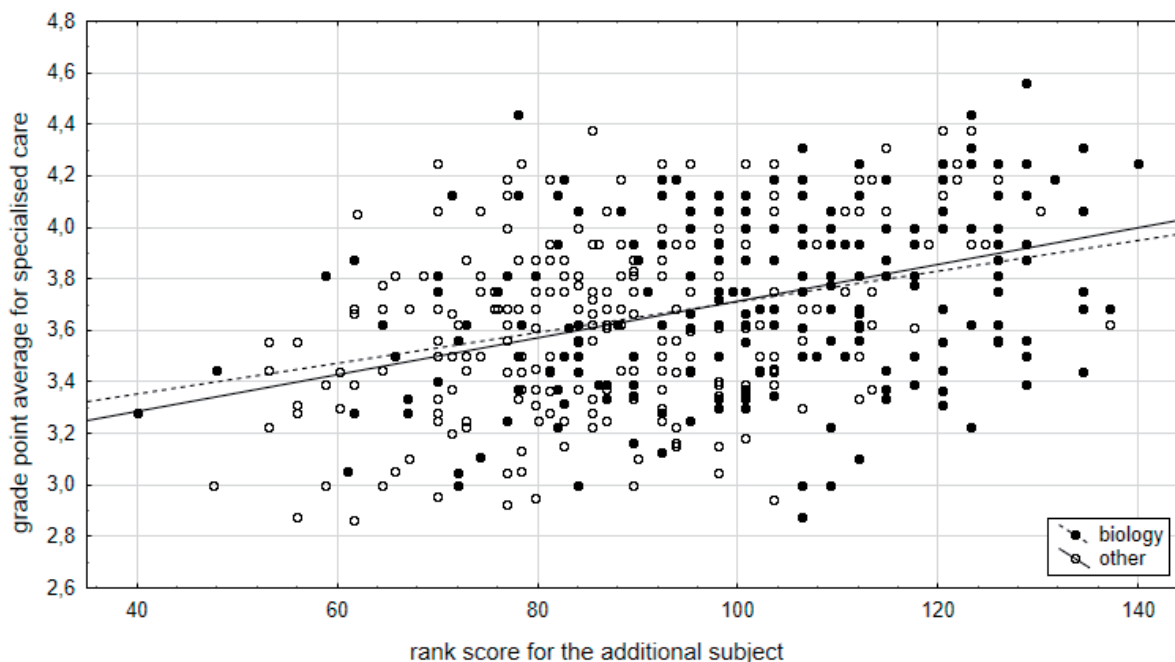
Source: author's own analysis

Due to the fact that the regression coefficients describing linear correlations between the rank scores for additional subjects and the grade point average for the specialised course among students taking biology and another additional subject in the matura exam were not significantly different ( $F = 0.466$ ;  $P = 0.495$ ; **Figure 1**), a co-variance model for uniform gradients was used to assess the differences. The covariate analysis (a rank score for the additional subject) showed a lack of significant differences in mean scores regarding specialised care between students who had passed Biology in the matura exam and those who had chosen another additional subject ( $F = 0.005$ ;  $P = 0.942$ ).

## Discussion

The available world literature has given a lot of attention to the predictive analysis of the assessment of the influence of various variables on educational success in Nursing/Midwifery programmes. The influence of the following issues was assessed: (I) preparation courses for studies [7, 8], (II) university entrance exams [7-10], (III) secondary school learning outcomes [11, 12], and (IV) achievements in basic science in the course of studies [12-14]. From among those listed above, factors referring to the predictive analysis of learning outcomes in basic sciences were of particular interest in the context of the present analysis.

An in-depth knowledge of biological functioning of the human body in health and in sickness is the framework of understanding the reasons why particular clinical management is considered to be safe and effective. Therefore, strong emphasis in teaching midwives is put on basic sciences, such as anatomy, physiology, and pathology [15]. Students themselves indicate the importance of this field in their vocational education [16]. Prowse observed that good preparation in biological sciences is the key to success in teaching clinical competence [17]. The formal requirements set forth in the respective European Union Directives (77/452/EEC, 77/453/EEC, 2005/36/EC) that say that at least 1/3 from among a minimum of 4600 teaching hours are supposed to be devoted to theoretical and technical training, covering the issues from basic and social sciences, as



**Figure 1.** Regression line describing linear correlation between the rank score for the additional subject and grade point average for specialised care among two groups of students divided by a chosen additional subject in the mature exam

Source: author's own analysis

well as basics of care also confirm this thesis [18-20]. Directive 2005/36/EC states that during their education process midwives and nurses are provided with “adequate knowledge of the sciences on which general nursing is based, including sufficient understanding of the structure, physiological functions and behaviour of healthy and sick persons (...)” [20].

The regression analysis showed that grades for “Physiology” were the only ones from among all basic science courses that did not have an important impact on future achievements in specialised care. Conversely, rank scores for additional subjects proved to have a very high predictive power. These results confirmed the assumptions presented earlier in the study which suggested that students with a strong academic background in biological sciences and a high level of initial competencies shall perform well in specialised care. These presumptions resulted from the fact that without thorough knowledge and understanding of anatomy or pathology a midwife cannot understand the importance of particular clinical symptoms and signs and thus, cannot take proper measures in specialised care [15, 17].

The analysis of potential influence of the predictors in question on educational outcomes of Midwifery students demonstrated the lack of important correlations between students’ grades for physiology and the grade point average for specialised care. This unexpected result contradicts the assumptions presented above and the findings by other authors [15, 17]. One of the reasons justifying such a discrepancy could be found in unsatisfactory accuracy of the measurement of learning outcomes used during the examination in “Physiology”. It is important to recognize that the adequacy of the examination tools is of key importance for the credibility of the system for assessing students’ performance [1, 21]. Sufficient validity of the methods of educational measurement is one of the most important points of a proper planning and management of the educational process. A proper assessment of students’ learning outcomes may be a measurement of the quality of teaching, yet it requires the use of standardised examination tools. However, while examination methods such as OSCE (Objective Structured Clinical Examination) or Mini-CEX (Clinical Evaluation Exercise) are being introduced to evaluate skills, non-standardised written tests are still widely used with respect to knowledge assessment. A lack of examination tests of proper quality that usually are not even evaluated leads to a decrease in the credibility of assessment, which is probably the case of “Physiology” mentioned above. Therefore, the present authors recommend a review of the methods used for measurement of learning outcomes in the “Physiology” course in

order to identify potential reasons of the lack of predictive value of grades for this subject.

Difficulties reported by students and associated with educational problems at classes in biological sciences may be caused by inadequate preparation of candidates for university studies [15, 22]. A study by Gresty showed that students who were well prepared in biology from their secondary school achieved better results in biological sciences in e-learning in the Nursing major [22]. Although an earlier correlation study by Ofori [23] on potential predictors of success in learning basic sciences contradicts the results obtained by Gresty [22], this issue needs further analysis. The present study results did not demonstrate a significant influence of the subject chosen by students in their matura exams on the learning outcomes in specialised care in the Midwifery major. Thus, these results did not prove the hypothesis that students who had chosen biology in their matura exam performed significantly better during clinical classes compared to the remaining students. The ANCOVA that additionally took into consideration the rank scores calculated during the admission procedure did not show the existence of such a correlation. Therefore, it seems that a mandatory requirement for using the results for the biology matura exam during the admission procedure is not empirically justified. This conclusion was also confirmed by the regression analysis which indicated that regardless of the subject chosen in the matura exam, the admission score for the selected subject was a strong predictor of educational success in specialised care.

Many researchers who deal with the issue of vocational training of nurses and midwives suggest that most countries have difficulties with teaching students basic sciences and putting it into practice in clinical activity [24]. It is emphasised that an adjustment of the curriculum to the initial competencies of students is necessary for proper management of the educational process in the first year of studies, particularly in the case of an expected increase in the number of candidates for Nursing and Midwifery. A reduction in the pressure of the admission procedure decreases certainty as to the quality of preparation of candidates for university studies. This may lead to an increase in the number of students who will have problems with mastering the basics of anatomy, physiology, or pharmacology. A lot of countries have introduced various methods of supporting students at the first stage of studies either by online or traditional contacts, e.g. with tutors. Another matter is the quality of classes that, to a large extent, should be problem-solving oriented and focused on developing critical thinking. Only such an approach guaran-

tees that the theory discussed, e.g. on microbiology or pharmacology, will have a practical dimension, which is necessary for the proper understanding of clinical management students will come into contact with during their specialised care classes [15, 24]. In support of the thesis stated above, Clarke concludes that we cannot talk about a holistic dimension of Nursing / Midwifery practice if we do not put emphasis in the education process on good education in basic sciences [25].

## Conclusions

1. The level of preparation of students in basic science is crucial for their future educational achievements associated with specialised care.
2. Caring about high quality of teaching midwives in the area of biological sciences is essential for providing efficient professional education in this major.
3. A mandatory requirement for using the results for the biology matura exam during the admission procedure for Midwifery probably does not improve the selection process of candidates for this major.
4. Improvement of quality of teaching of basic sciences should include an introduction of modern teaching methods (e-learning, problem-based learning, critical thinking learning models) on the one hand, and conversely, the use of standardised and adequate methods for measuring learning outcomes.

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