Quantitative and Qualitative Analysis on Sex and Gender in Preparatory Material for National Medical Examination in Germany and the United States

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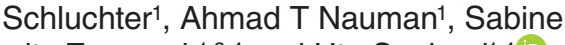

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ABSTRACT

BACKGROUND: Sex- and gender-based medicine (SGBM) should be a mandatory part of medical education. We compared the quantity and quality of sex- and gender-related content of e-learning materials commonly used by German and American medical students while preparing for national medical examinations.

METHODS: Quantitative, line-by-line analysis of the preparatory materials AMBOSS 2017 and USMLE Step 1 Lecture Notes (2017) by KAPLAN MEDICAL was performed between April and October 2017. Subjects were allocated to one of the three main fields: *clinical subjects, behavioral and social science*, and *pharmacology*. Qualitative analysis comprised binary categorization into sex- and gender-based aspects and qualification with respect to the presence of a pathophysiological explanation for the sex or gender difference.

RESULTS: In relation to the total content of AMBOSS and KAPLAN, the sex- and gender-based share of the clinical subjects content was 26.8% (±8.2) in AMBOSS and 21.1% (±10.2) in KAPLAN. The number of sex- and gender-based aspects in the behavioral and social science learning material differed significantly for AMBOSS and KAPLAN (4.4% ± 3.1% vs 10.7% ± 7.5%; $P = .044$). Most of the sex- and gender-related content covered sex differences. Most learning cards and texts did not include a detailed pathophysiological explanation for sex- or gender-based aspects. The knowledge provided in the preparatory documents represents only a small part of facts that are already known about sex and gender differences.

CONCLUSIONS: The preparatory materials focused almost exclusively on biological sex differences and the sociocultural dimension in particular is underrepresented. A lot more evidence-based facts are known and should be integrated into the materials to reflect the importance of SGBM as an integral component of patient-centered medicine.

KEYWORDS: Sex- and gender-based medicine, medical education, sex differences, e-learning, national medical examination, learning material

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Introduction

Medical knowledge of biological sex differences as well as the awareness of socially constructed characteristics of the individual (gender) are recommended to use for diagnosis and therapy in daily clinical practice. Therefore, sex- and gender-based medicine (SGBM), as an integral component of patient-centered medicine, should be a mandatory part of medical education and national medical exams.[1,2]

Based on the definition of "sex and gender" used by the Canadian Institutes of Health Research (CIHR) and the Institute of Gender in Medicine in Germany, "gender" is a psychosocial construct comprising four main features: gender roles, gender identity, gender relations, and institutionalized gender. "Sex" refers to a set of biological attributes in humans and animals. It is primarily associated with physiological features including chromosomes, gene expression, hormone levels and function, and reproductive/sexual anatomy.[3,4] Neither sex nor gender should be looked at solely due to their reciprocal influence of each other, and their joint impact on health.[5] The study by Pelletier et al.[6] laid the groundwork for the objective measurement of gender. This new ability to quantify the effect size of gender aspects in studies will lead to much more knowledge about the risk factors that contribute to the onset of disease.

Incorporation and translation of new facts based on sex and gender research into educational programs is challenging though.[7,8] While medical curricula vary widely between universities, all medical students take nationwide standardized examinations, which therefore function as indicators for the governmental framework regarding the implementation of SGBM into medical education. Neither the German nor the

American regulatory guidelines on medical licensing explicitly incorporate sex- or gender-based aspects in their learning outcomes apart from reproductive aspects and sexual disorders.[9-11]

To examine the extent of the implementation of SGBM and therefore the students' sex- and gender-related medical knowledge, this study analyzes the learning material used to prepare for standardized national medical exams. All German medical students take the German state examination, a 3-day written, multiple-choice exam, at the end of their fifth year at university and before entering the 1-year clinical internship. The American counterpart with a comparable scope and value, the USMLE Step 1, is a 1-day written, multiple-choice exam, most medical students take at the end of their second year in medical school.

This study analyzes the e-learning materials of AMBOSS 2017 (https://amboss.miamed.de), a web-based knowledge platform used by 95% of German medical students to prepare for the German state examination,[12] and of USMLE Step 1 Lecture Notes (2017), an e-book series by KAPLAN MEDICAL, one of the leading companies in the test prep industry, and used by thousands of American students,[13] to test the hypothesis that the preparatory materials for the German and the American national medical exams incorporate sex- and gender-related content based on the already published scientific knowledge and that German and American medical students are therefore equally well prepared in the field of SGBM.

Methods

AMBOSS is a continuously updated, web-based knowledge platform, offering, inter alia, a comprehensive set of learning cards that cover the topics tested in the German state examination. The annually revised KAPLAN e-book series comprises seven volumes, each tailored for an examination subject of the USMLE Step 1. The subjects included in the analysis were allocated to one of the 3 main fields: *clinical subjects, behavioral and social science*, and *pharmacology*. To increase comparability, subjects specific to only one of the learning resources were not included in the analysis.

For a systematic analysis of sex- and gender-related content, a last year medical student who has been trained in sex and gender medicine for 3 years at the Institute for Gender in Medicine at Charité—Universitaetsmedizin Berlin performed a line-by-line analysis of the preparatory materials between April and October 2017 and was observed by a senior medical scientist expert for SGBM. Furthermore, a second expert in the field analyzed a randomly selected and representative sample size of the reviewed content with an inter-rater reliability (IRR) of 92.50%.

For the quantitative analysis of the respective preparatory material's sex and gender awareness, each AMBOSS learning card and KAPLAN e-book chapter were assessed for the presence of sex- or gender-based aspects with respect to the eight categories: *epidemiology, prevention, pathophysiology, clinical presentation, diagnostics, therapy, prognosis*, and *pregnancy*. A section counted as sex- and gender-aware if there was at least one sex- or gender-based aspect included. After determining each subject's share of sex- and gender-related content, the overall sex- and gender-awareness percentage for every main field was calculated. We used the weighted arithmetic mean of the respective subjects' sex- and gender-awareness scores, considering their differing shares of the overall content.

The second step comprised the qualitative coding of the preparatory material by (1) binary categorization into sex-based aspects (biological differences of women and men) and gender-based aspects (socially constructed traits/characteristics attributed to an individual) and (2) qualification with respect to the presence or absence of a (patho-)physiological explanation for the stated sex or gender differences.

Statistical analysis

Descriptive and statistical data analyses were conducted using Microsoft Excel for Macintosh 16.12 and IBM SPSS Statistics 24 (Released 2016; IBM SPSS Statistics for Macintosh, Version 24.0; IBM Corp., Armonk, NY, USA), respectively. Inter-rater reliability was measured as the percent agreement between raters. Data were expressed in percentages for nominal variables. Significance of differences in sex- and gender-related content was calculated using Pearson chi-square test. A P value less than .05 was considered statistically significant.

Results

The distribution of the allocated subjects differed slightly between AMBOSS and KAPLAN. The learning material allocated to the category *clinical subjects* was 51.76% in AMBOSS and 35.71% in KAPLAN; 9.41% in AMBOSS and 14.29% in KAPLAN for *behavioral and social science*; and 5.8% in AMBOSS and 14.29% in KAPLAN for *pharmacology*. Subjects which presented with little content or were specific to either AMBOSS or KAPLAN were excluded from the analysis (Supplementary Table 1).

Quantitative analysis of the percentage of sex- and gender-related content of all analyzed subjects showed 84.2% within the *immunology/rheumatology* section of AMBOSS and 50% within the KAPLAN counterpart ($P < .1$). Sex- or gender-based aspects were mentioned in 35.7% of the AMBOSS learning cards covering the subject *occupational and environmental medicine*. Its counterpart, the KAPLAN chapter *social sciences*, did not contain a single sex- or gender-based aspect ($P < .05$). Analyzing the *psychiatry* content, 46.9% in AMBOSS, compared to 76.9% of KAPLAN *behavioral science* section, mentioned sex- or gender-based facts ($P < .1$). For the following subjects, the difference between the percentage of sex- and gender-related content of the AMBOSS and the KAPLAN learning material was less than 10%: *endocrinology/endocrine pathology, hepatogastroenterology/hepatogastrointestinal pathology, nephrology/renal pathology, pneumology/respiratory pathology*, and *pharmacology. Epidemiology* was identified as the only subject in both preparatory materials that contained at least one sex- or gender-based aspect in every e-learning card or e-chapter (sex- and gender-awareness of 100%).

Table 1. Proportion of sex- and gender-related content of main fields in relation to total content of AMBOSS and KAPLAN.

MAIN FIELD	AMBOSS (100%)	KAPLAN (100%)	*P* VALUE
Clinical subjects			
Total content (%)	51.76	35.71	
S&G-related content (SD%)	26.83 (±8.2)	21.12 (±10.2)	.306
Behavioral and social science			
Total content (%)	9.41	14.29	
S&G-related content (SD%)	4.39 (±3.1)	10.71 (±7.5)	.044*
Pharmacology			
Total content (%)	5.88	14.29	
S&G-related content (%)	3.80	7.87	.341

Abbreviations: S&G, sex and gender; SD, standard deviation.
*$P < .05$.

In relation to the total content of AMBOSS and KAPLAN (Table 1), the sex- and gender-based share of the AMBOSS clinical subjects e-learning cards was 26.8% (±SD 8.2%) and the KAPLAN counterpart 21.1% (±SD 10.2%). The percentage of sex- and gender-related content within the *behavioral and social science* learning material differed significantly between AMBOSS and KAPLAN (4.4% ± 3.1% vs 10.7% ± 7.5%; $P = .044$). Within the main field *pharmacology*, 3.8% of the AMBOSS learning cards were sex- and gender-aware in comparison to 7.9% of the KAPLAN *pharmacology* chapters, however not significantly different.

Figure 1A and B show the distribution of the sex- and gender-based aspects to the eight categories in the main fields *clinical subjects* and *behavioral and social science*. Approximately half of the sex- and gender-based aspects belonged to the category *epidemiology*. AMBOSS put further emphasis on the categories *clinical presentation, diagnostics*, and *therapy*. KAPLAN, however, focused on *pathophysiology* and *clinical presentation*. Learning material presenting facts concerning *pregnancy* was included in both. In the *clinical subjects* content, the following categories demonstrated significant differences between AMBOSS and KAPLAN: *epidemiology* (48.1% vs 39.7%; $P = .024$), *pathophysiology* (2.5% vs 28.5%; $P < .001$), *diagnostics* (9.8% vs 3.7%; $P = .002$), *therapy* (5.6% vs 0.7%; $P = .001$), and *pregnancy* (14.3% vs 9.4%; $P = .045$). The *behavioral and social science content* of AMBOSS and KAPLAN differed significantly in the following categories: *pathophysiology* (0% vs 14.6%; $P = .002$) and *diagnostics* (7.0% vs 0%; $P = .009$).

The pharmacological content of both AMBOSS and KAPLAN (Figure 1C) focused on sex- and gender-based aspects regarding therapy (43.6% vs 58.8%; $P = .052$), including differences in side effects between women and men and special instructions for the medical care of pregnant women, stating particular indications and contraindications.

The overwhelming majority of the sex- and gender-related content in the preparatory material covered sex-based and therefore biological aspects (Table 2). Neither the *clinical subjects* nor the *pharmacology* content of either learning resource contained a single gender-based aspect. With 86.0% and 86.5%, sex-based aspects also predominated in the *behavioral and social science* content of AMBOSS and KAPLAN.

Most learning cards and texts did not include a detailed pathophysiological explanation for sex or gender differences with a similar distribution pattern between the learning resources (Table 3). The *pharmacology* content contained the biggest share of explained sex- and gender-based aspects with 34.6% for AMBOSS and 23.5% for KAPLAN.

Discussion

The results indicate that the preparatory materials frequently used for preparing for the German and the American national medical exams contain sex- and gender-related content. Nevertheless, there is a lack of quantity and quality in regard to covering SGBM topics.

The main findings of the data analysis are as follows: (1) the overall lack of explicitly gender-related content in AMBOSS and KAPLAN, (2) the lack of a higher educational level regarding the comprised sex- and gender-based aspects in both preparatory materials, and (3) the significantly higher share of sex- and gender-related content incorporated in the main field *behavioral and social science* in KAPLAN compared to AMBOSS.

The vast majority of the included SGBM aspects in both learning materials comprised sex differences. This imbalance between biological facts (sex) and gender-based content (sociocultural aspects) could be explained by the challenge of measuring gender accurately. The study by Pelletier et al[6] laid the groundwork for the objective measurement of gender. They ranked patients having suffered from premature acute coronary

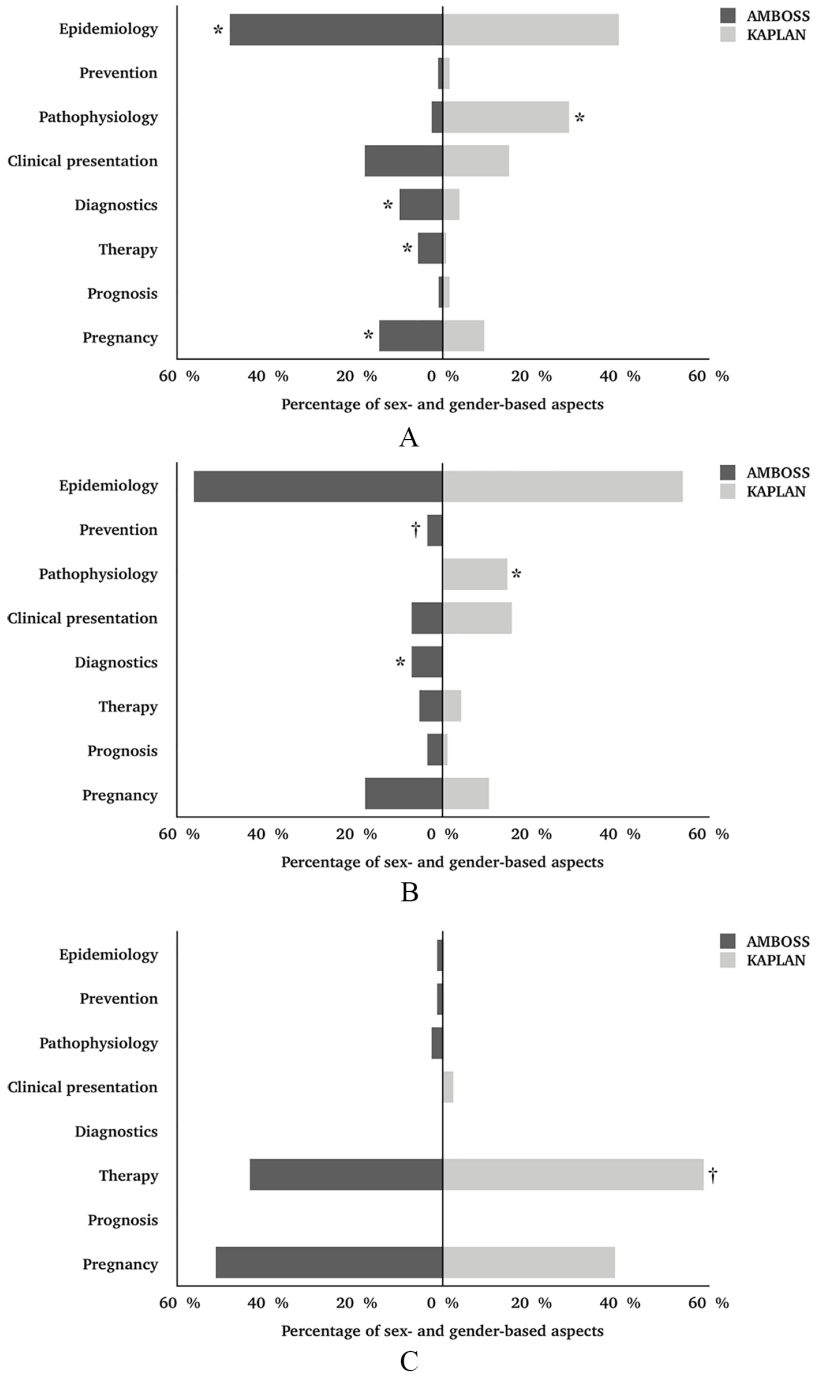

Figure 1. Distribution of sex- and gender-based aspects to eight categories in the main fields: (A) clinical subjects, (B) behavioral and social science, and (C) pharmacology. Comparison of AMBOSS and KAPLAN.
*$P < .05$; †$P < .1$.

syndrome on a masculinity/femininity-continuum according to their answers to a detailed questionnaire on sociocultural (gender) determinants (eg, income, education, social networks, environment, health literacy, cultural values), thus determining an individual's gender score in addition to an individual's biological sex. When implemented in clinical trials, this questionnaire will support and advance further research on sociocultural risk factors for diseases, and the obtained findings could lead to new gender-based preventive approaches.

Nevertheless, there are already sex- and gender-based facts that should be added as soon as possible to the exam questions pool. For example, atrial fibrillation increases embolic risk in women more than in men. Thus, at a societal level, women bear a greater burden of stroke than men.[14-16] Heart failure (HF) is commonly associated with reduced ejection fraction (HFREF). However, this connection is predominantly found in men, whereas women more often suffer from HF with preserved ejection fraction (HFPEF).[17-19] These symptoms occur based

Table 2. Qualitative analysis of preparatory material separated according to sex-based aspects and gender-based aspects, comparison of AMBOSS and KAPLAN.

MAIN FIELDS	PREPARATORY MATERIAL WITH S&G-BASED ASPECTS, N (%)	
	AMBOSS	KAPLAN
Clinical subjects	551 (100)	267 (100)
Sex-based aspects	551 (100)	267 (100)
Gender-based aspects	0 (0)	0 (0)
Behavioral and social science	57 (100)	96 (100)
Sex-based aspects	49 (85.96)	83 (86.46)
Gender-based aspects	8 (14.04)	13 (13.54)
Pharmacology	78 (100)	85 (100)
Sex-based aspects	78 (100)	85 (100)
Gender-based aspects	0 (0)	0 (0)

Abbreviations: S&G: sex and gender.

Table 3. Qualitative analysis: list of two educational levels of the preparatory material with sex- and gender-related content: (1) with pathophysiological explanation and (2) with no pathophysiological explanation.

MAIN FIELDS	PREPARATORY MATERIAL WITH S&G-BASED ASPECTS, N (%)	
	AMBOSS	KAPLAN
Clinical subjects	551 (100)	267 (100)
With explanation	96 (17.42)	38 (14.23)
No explanation	455 (82.58)	229 (85.77)
Behavioral and social science	57 (100)	96 (100)
With explanation	2 (3.51)	4 (4.17)
No explanation	55 (96.49)	92 (95.83)
Pharmacology	78 (100)	85 (100)
With explanation	27 (34.62)	20 (23.53)
No explanation	51 (65.38)	65 (76.47)

Abbreviations: S&G, sex and gender.

on diastolic dysfunction. Increased arterial pulse wave velocity (PWV $\leq$ 9.7 m/s) and waist circumference >80 cm in postmenopausal women are associated with an increased risk of myocardial diastolic dysfunction.[20] Peripartum cardiomyopathy is a potentially life-threatening condition with multiple predisposing factors.[21] Therefore, it should be added to the exam topics as well. Diabetes is a stronger risk factor for vascular disease in women than in men.[22] Clinical presentation of systemic lupus erythematosus differs between women and men.[23-25] Women present with earlier onset of disease and more frequent relapses of multiple sclerosis (MS). However, progression is faster, and outcome is worse in men with MS.[26,27] A lot more evidence-based facts should be included in the exam questions pool. For additional information and literature on these facts, please refer to Table 4 highlighting knowledge gaps by way of example.

Epidemiological sex- and gender-based aspects accounted for a large number of the total amount of detected data. The predominant absence of pathophysiological explanations for sex and gender differences supports the conclusion that sex- and gender-related content only serves as additional information. This could be caused by a lack of scientific evidence in regard to the pathophysiological mechanisms underlying the influence of sex and gender on health and disease or a lack of prioritization of sex- and gender-related knowledge in the preparatory materials and the respective standardized examinations.

Medical curricula emphasize so-called "hot topics" (areas considered of special importance by the accrediting body for medical schools in the United States and Canada), defined by the Liaison Committee on Medical Education.[38] In Germany, medical curricula should be based on the National Competency–based Learning Objective Catalog Medicine (NKLM). It is a competence-based core curriculum with a recommendation character (https://review.nklm.de/zend/).

Hochleitner et al[39] observed a discrepancy between the amount of evidence provided by sex- and gender-based research and its integration into conventional learning resources, which still consider the male body and physiology as the norm. Lack of support and guidance on an institutional (ie, medical faculties) and a governmental level (ie, compulsory guidelines) were considered influencing factors on the failure of a systematic SGBM implementation in medical education.

In accordance with the predominantly epidemiological data findings in this study, Song et al[40] found most of the sex- and gender-related content in their analysis on sex and gender of the Texas Tech University Health Sciences Center™ School of Medicine's curriculum to be either of epidemiological nature or anatomy- and physiology-related. They discovered only incomplete coverage of many of the sex- and gender-based topics, which correlates with our finding that the analyzed preparatory materials rarely offered pathophysiological explanations for sex- and gender-based aspects. In a national student survey conducted by Jenkins et al,[41] clinical subjects such as endocrinology, rheumatology, cardiology, and pulmonology were considered to be covered moderately to extensively in regard to SGBM. However, more than half of the participants did not feel well prepared for transferring this sex- and gender-related knowledge into clinical practice.

As long as the implementation of sex- and gender-based medicine knowledge is not systematically integrated into the training and is not sufficiently taken into account in the exam questions, the students could only turn to alternative resources such as eGender, a web-based interactive knowledge sharing platform for sex- and gender-based medical education.[42]

Table 4. Examples of sex- and gender-related content identified in selected sections, facts not included in the learning materials, and knowledge gaps identified for future research.

PATHOLOGY	AMBOSS	KAPLAN	FACTS NOT INCLUDED AND KNOWLEDGE GAPS
Cardiology			
Atrial fibrillation (AF)	Epidemiology: M > F Prognosis: CHA2DS2-VASc score for estimating the risk of stroke in patients with AF, Sc = sex category (ie, female sex)		More women than men live with atrial fibrillation because of age dependency and greater longevity in women. Atrial fibrillation increases embolic risk more in women than in men. Women with stroke are more likely to have atrial fibrillation (leading to embolic stroke) and hypertension than men with stroke.[14] Adjusted data do suggest a lower case fatality in women.[15] Thus, at a societal level, women bear a greater burden of stroke than men, largely driven by their longer life expectancy and the higher risk of stroke with advancing age. In AF patients, female sex is associated with an age-dependent moderate risk of stroke and should be regarded as a stroke risk modifier relevant in the presence of other CHA2DS2-VASc risk stroke factors, rather than an independent stroke risk factor. AF patients aged <65 years, with a CHA2DS2-VASc score of 1 due to female sex have low annual stroke rates (generally <1%) and do not need any antithrombotic therapy. Women with AF and ⩾1 additional stroke risk factor (ie, with a CHA2DS2-VASc score of ⩾2) should be considered for OAC.[16]
Dilated cardiomyopathy (DCM)	Epidemiology: M: F = 3:1	Pregnancy: some cases are related to pregnancy	Epidemiology data based on traditional definition of heart failure with reduced ejection fraction (HFREF). Female and male patients with HF who are treated in European hospitals differ in terms of clinical manifestations. In the Euro Heart failure survey, systolic HF, known as HF with reduced ejection fraction (HFREF), was found predominantly in men, whereas women presented with HF with preserved (normal) ejection fraction (HFPEF) or diastolic HF. DCM is a heterogeneous condition manifest in a diverse group of patients due to a combination of underlying genetic susceptibility and environmental insults.[28] Women with DCM have better survival compared to men, which may partly be due to less severe left ventricular dysfunction and a smaller scar burden.[29] Takotsubo CMP (TTC): Initial clinical presentation of TTC often mimics ST-elevation myocardial infarction (STEMI), including acute chest pain, ST-segment elevation, and raised cardiac biomarkers.[30] TTC mostly occurs in postmenopausal women and has been associated with acute stress, smoking, alcohol abuse, and hypercholesterolemia.[31] It is yet unclear why TTC is more often observed in women. Peripartum Cardiomyopathy (PPCM) is a potentially life-threatening condition typically presenting as heart failure with reduced ejection fraction (HFREF) in the last month of pregnancy or in the months following delivery in women without another known cause of heart failure. Predisposing factors for PPCM seem to be multiparity and multiple pregnancies, family history, ethnicity, smoking, diabetes, hypertension, pre-eclampsia, malnutrition, age of mother (with older mothers being at greater risk), and prolonged use of tocolytic beta-agonists.[21]
Ischemic Heart Disease	Epidemiology: M > F (2:1) Clinical presentation: frequently only retrosternal "pressure" (as opposed to pain) in women, exclusively unspecific vegetative symptoms possible	Epidemiology: cardiac ischemia is most often seen in middle-aged men and postmenopausal women Clinical presentation: atypical presentation of myocardial infarction with little or no chest pain is seen most frequently in women	Epidemiology data based on traditional pathophysiology with catheter-based obstruction of main coronary arteries. In women, more often ischemic heart diseases without obstruction of the main coronary arteries occur because of heterogeneous diseases and/or microvascular dysfunction, known as INOCA (myocardial ischemia with no obstructive coronary arteries)[32] and MINOCA (myocardial infarction with nonobstructed coronary arteries).[33]

(Continued)

Table 4. (Continued)

PATHOLOGY	AMBOSS	KAPLAN	FACTS NOT INCLUDED AND KNOWLEDGE GAPS
Endocrinology			
Diabetes mellitus	Clinical presentation: urogenital—erectile dysfunction Pregnancy: gestational diabetes, a glucose tolerance disorder arising or being diagnosed for the first time during pregnancy	Clinical presentation: diabetic neuropathy can cause sexual impotence	Diabetes is a stronger risk factor for vascular disease in women than men. Diabetes confers a 44% greater excess risk of coronary heart disease (CHD) and a 27% greater excess risk of stroke in women than in men, independent of sex differences in other major risk factors.[22] *Knowledge gap*: *The evidence is incomplete and the reasons behind women's excess vascular relative risk from diabetes are not fully understood. Further research is therefore needed to provide further insights.*
Graves disease	Epidemiology: F > M (5:1) Diagnostics: enlarged thyroid gland (F > 18 mL, M > 25 mL)	Epidemiology: women are affected more frequently than men	Thyroid diseases afflict far more women than men. Hypothyroidism and hyperthyroidism are about 10 times more common in women than in men. Thyroid nodules and thyroid cancer are about three times more common in women than in men.[34] Men treated with antithyroid drugs had fewer adverse events (9% vs 18%) and treatment discontinuation (5% vs 16%) compared to women.[35]
Hepatogastroenterology			
Cholelithiasis	Epidemiology: 6F mnemonic for risk factors: "fair (white), family (positive family history), fat (BMI > 30), woman, fertile, forty (age ⩾ 40 years)"	Epidemiology: risk factors for cholesterol stones include female gender, pregnancy, oral contraceptives, and hormone replacement therapy	*New sex and gender sensitive facts are missing*
Chronic pancreatitis		Epidemiology: it is common in middle-aged male alcoholics	Clinical presentation: men have a 40% higher risk of developing diabetes (associated with diseases of the exocrine pancreas) than women.[36]
Hereditary nonpolyposis colorectal cancer (HNPCC)	Clinical presentation: increased risk of cancer at other sites: endometrial cancer (40%-60% of affected women) and ovarian cancer (10% of affected women) Prevention: annual gynecological exams including transvaginal sonography for affected women aged 25 years and older; annual endometrial biopsies for affected women aged 35 years and older	Clinical presentation: it is associated with an increased risk of cancer at other sites, including the endometrium and the ovary	*New sex and gender sensitive facts are missing*

(Continued)

Table 4. (Continued)

PATHOLOGY	AMBOSS	KAPLAN	FACTS NOT INCLUDED AND KNOWLEDGE GAPS
Immunology/rheumatology			
Scleroderma (progressive systemic sclerosis)	Epidemiology: F > M (3:1) Prognosis: Men have a poorer prognosis than women	Epidemiology: it affects women more than men	Sex ratio of women to men with SSc prior to menopause is estimated at 15:1, while it lowers to 2.4:1 after menopause.[37]
Sjögren syndrome (sicca syndrome)	Epidemiology: F > M (10:1), especially women during menopause	Epidemiology: women are affected more often than men	*New sex and gender sensitive facts are missing*
Systemic lupus erythematosus (SLE)	Epidemiology: F > M (10:1)	Epidemiology: women are affected much more often than men (F:M = 9:1)	Alopecia, photosensitivity, oral ulcers, arthritis, malar rash, lupus anticoagulant level, and low level of C3 were significantly higher in female lupus patients, whereas renal involvement, serositis and pleurisies, thrombocytopenia, and anti-double-stranded deoxyribonucleic acid level were predominant in male patients with SLE.[25] The primary cause of mortality in female patients with SLE is cardiovascular disease.[24] Hypertension, thrombosis, and embolism have high prevalence rates in these women.[23]
Nephrology			
IgA nephropathy (Berger disease)	Epidemiology: risk factors for an unfavorable course include "men under the age of 30 years"	Epidemiology: it affects children and young adults, mostly men	*New sex and gender sensitive facts are missing*
Pyelonephritis	Epidemiology: F > M	Epidemiology: it affects women much more than men, but the incidence increases in older men with prostatic hyperplasia	*New sex and gender sensitive facts are missing*
Urinary tract infection (UTI)	Epidemiology: predisposing factors include female sex; a UTI in men always requires further investigation Diagnostics: every suspicion of an UTI is indication for a urine culture, except in women with uncomplicated UTIs	Epidemiology: clinically, it affects women far more than men; predisposing factors include benign prostatic hypertrophy and cystocele	*New sex and gender sensitive facts are missing*
Urolithiasis	Epidemiology: M > F	Epidemiology: men are affected more often than women	*New sex and gender sensitive facts are missing*

(Continued)

Table 4. (Continued)

PATHOLOGY	AMBOSS	KAPLAN	FACTS NOT INCLUDED AND KNOWLEDGE GAPS
Neurology			
Meningioma	Epidemiology: F > M (3:2)	Epidemiology: it is common in adults, F > M	*New sex and gender sensitive facts are missing*
Multiple sclerosis (MS)	Epidemiology: F > M (2:1), typically young women	Epidemiology: women have two times the risk of men	Gender differences include earlier disease onset and more frequent relapses in women and faster progression and worse outcomes in men. Hormone-related physiological conditions in women such as puberty, pregnancy, puerperium, and menopause also exert significant influence both on disease prevalence and on outcomes.[27] *Knowledge gap*: *To date, however, due to a lack of systematic studies on treatment responses in males versus females, evidence in this area is still sparse. We argue that studies taking sex differences into account could pave the way for sex-specific and therefore personalized treatment.*[26]
Myasthenia gravis	Epidemiology: F > M (3:2); two peaks in frequency between age 30 and 40 years (more women) and age 60 and 80 years (more men) Clinical presentation: symptoms often increase during menstruation	Epidemiology: women are affected more frequently than men	*New sex and gender sensitive facts are missing*
Pneumology			
Lung cancer	Epidemiology: M > F (3:1); leading cause of death among both men and women; second most common carcinoma in men and third most common carcinoma in women Epidemiology: squamous cell carcinoma is the most common non-small-cell lung carcinoma (NSCLC) in men (45%); adenocarcinoma is the most common NSCLC in women (40%)	Epidemiology: lung cancer is the leading cause of death among both men and women; it has been increasing in women (increased smoking) in the past few decades Epidemiology: adenocarcinoma is more commonly seen in women; squamous cell carcinoma and small-cell carcinoma affect men more than women	*New sex and gender sensitive facts are missing*
Sarcoidosis	Epidemiology: over all F = M; especially young women are affected by Löfgren syndrome	Epidemiology: the disease affects women more than men	*New sex and gender sensitive facts are missing*
Tuberculosis	Epidemiology: M > F Clinical presentation: urogenital tuberculosis in men (e.g. prostatitis) and women (eg, adnexitis)	Clinical presentation: sites that may become involved include fallopian tubes and epididymis	*New sex and gender sensitive facts are missing*

Abbreviations: BMI, body mass index; F, female; M, male; ml, milliliter; S&G, sex & gender; SSc, systemic sclerosis.

The comparison of the preparatory materials provided evidence to support the conclusion that KAPLAN had a significantly higher share of sex- and gender-related content in the main field *behavioral and social science*, probably due to the two countries' differing approaches for addressing socioeconomic aspects within the medical curriculum. In the United States, *behavioral and social science* is considered an independent subject within medical education. In contrast, German medical curricula often integrate socioeconomical aspects of health and disease into a clinical subject's syllabus, reflected in the lack of sex- and gender-related content in the main field *behavioral and social science* in AMBOSS.

Limitations

This study only investigated two distinct preparatory materials. While they are popular among medical students, there are also other commercial learning resources available. Nevertheless, AMBOSS and KAPLAN aim to offer a comprehensive preparation for the German state examination and the USMLE Step 1, respectively, and are both geared toward those standard examinations. Furthermore, we focused on a selection of subjects and did not include all subjects in our analysis to increase comparability between the two preparatory materials.

Conclusions

The sex- and gender-related content of the preparatory materials focuses almost exclusively on biological sex differences. Gender is an important influencing factor on health and disease that should be further integrated into the preparatory materials for national medical exams. The supplemental character of the gender-based content in learning resources fails to reflect the importance of SGBM as an integral component of patient-centered medicine.

Author Contributions

US and HS conceived of the presented idea and developed the theory. HS and SL performed the analysis. ATN and US verified the analytical methods. VRZ supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

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Supplemental Material

Supplemental material for this article is available online.

REFERENCES

1. Regitz-Zagrosek V. Sex and gender differences in health. Science & society series on sex and science. *EMBO Rep*. 2012;13:596-603. doi:10.1038/embor.2012.87.
2. Regitz-Zagrosek V, Seeland U. Sex and gender differences in clinical medicine. *Handb Exp Pharmacol*. 2012:214:3-22. doi:10.1007/978-3-642-30726-3_1.
3. Johnson JL, Greaves L, Repta R. Better science with sex and gender: facilitating the use of a sex and gender-based analysis in health research. *Int J Equity Health*. 2009;8:14. doi:10.1186/1475-9276-8-14.
4. Canadian Institutes of Health Research (CIHR). Definitions of sex and gender. http://www.cihr-irsc.gc.ca/e/47830.html. Updated June 17, 2015.
5. Davidson KW, Trudeau KJ, van Roosmalen E, Stewart M, Kirkland S. Gender as a health determinant and implications for health education. *Health Educ Behav*. 2006;33:731-743; discussion 744. doi:10.1177/1090198106288043.
6. Pelletier R, Ditto B, Pilote L. A composite measure of gender and its association with risk factors in patients with premature acute coronary syndrome. *Psychosom Med*. 2015;77:517-526. doi:10.1097/PSY.0000000000000186.
7. Ludwig S, Dettmer S, Peters H, Kaczmarczyk G. Geschlechtsspezifische Medizin in der Lehre: Noch in den Kinderschuhen. *Dtsch Arztebl International*. 2016;113:A2364-A2366.
8. Miller VM, Kararigas G, Seeland U, et al. Integrating topics of sex and gender into medical curricula-lessons from the international community. *Biol Sex Differ*. 2016;7:44. doi:10.1186/s13293-016-0093-7.
9. Approbationsordnung für Ärzte. http://www.gesetze-im-internet.de/_appro_2002/BJNR240500002.html. Updated June 27, 2002 and July 17, 2017.
10. Institut für medizinische und pharmazeutische Prüfungsfragen. IMPP-Gegenstandskatalog (IMPP-GK 2) für den Zweiten Abschnitt der Ärztlichen Prüfung. https://www.impp.de/pruefungen/allgemein/gegenstandskataloge.html?file=files/PDF/Gegenstandskataloge/Medizin/gk2_2013.pdf. Updated 2013.
11. Step 1: Content Outline and Specifications. http://www.usmle.org/step-1/#content-outlines. Updated 2019.
12. Heinrich C. Amboss": Lernen wie von selbst. https://www.zeit.de/2018/20/amboss-lernplattform-mediziner. Updated 2018.
13. Johnson J, Jordan E, Burton W, Silbiger S. Are questions the answer? The effect of popular study resources on USMLE step 1 performance. https://members.aamc.org/eweb/upload/Are%20Questions%20the%20Answer%20PPT%2011-6-12%2010PM.pdf. Updated 2011.
14. Di Carlo A, Lamassa M, Baldereschi M, et al. Sex differences in the clinical presentation, resource use, and 3-month outcome of acute stroke in Europe: data from a multicenter multinational hospital-based registry. *Stroke*. 2003;34:1114-1119. doi:10.1161/01.STR.0000068410.07397.D7.
15. Niewada M, Kobayashi A, Sandercock PA, Kaminski B, Czlonkowska A. Influence of gender on baseline features and clinical outcomes among 17,370 patients with confirmed ischaemic stroke in the international stroke trial. *Neuroepidemiology*. 2005;24:123-128. doi:10.1159/000082999.
16. Kirchhof P, Benussi S, Kotecha D, et al. 2016 ESC guidelines for the management of atrial fibrillation developed in collaboration with EACTS. *Europace*. 2016;18:1609-1678. doi:10.1093/europace/euw295.
17. Meyer Brouwers FP, Voors AA, Hillege HL, et al. Sex differences in new-onset heart failure. *Clin Res Cardiol*. 2015;104:342-350. doi:10.1007/s00392-014-0788-x.
18. Merrill Sweitzer NK, Lindenfeld J, Kao DP. Sex differences in outcomes and responses to spironolactone in heart failure with preserved ejection fraction: a secondary analysis of TOPCAT trial. *JACC Heart Fail*. 2019;7:228-238. doi:10.1016/j.jchf.2019.01.003.
19. Stolfo D, Uijl A, Vedin O, et al. Sex-based differences in heart failure across the ejection fraction spectrum: phenotyping, and prognostic and therapeutic implications. *JACC Heart Fail*. 2019;7:505-515. doi:10.1016/j.jchf.2019.03.011.
20. Seeland U, Brecht A, Nauman AT, et al. Prevalence of arterial stiffness and the risk of myocardial diastolic dysfunction in women. *Biosci Rep*. 2016;36:e00400. doi:10.1042/BSR20160276
21. Bauersachs J, Konig T, van der Meer P, et al. Pathophysiology, diagnosis and management of peripartum cardiomyopathy: a position statement from the heart failure association of the European Society of Cardiology Study Group on peripartum cardiomyopathy. *Eur J Heart Fail*. 2019;21:827-843. doi:10.1002/ejhf.1493.
22. Peters SA, Huxley RR, Woodward M. Diabetes as a risk factor for stroke in women compared with men: a systematic review and meta-analysis of 64 cohorts, including 775,385 individuals and 12,539 strokes. *Lancet*. 2014;383:1973-1980. doi:10.1016/S0140-6736(14)60040-4.
23. Culwell KR, Curtis KM, del Carmen Cravioto M. Safety of contraceptive method use among women with systemic lupus erythematosus: a systematic review. *Obstet Gynecol*. 2009;114:341-353. doi:10.1097/AOG.0b013e3181ae9c64.
24. Ryan MJ. The pathophysiology of hypertension in systemic lupus erythematosus. *Am J Physiol Regul Integr Comp Physiol*. 2009;296:R1258-R1267. doi:10.1152/ajpregu.90864.2008.
25. Boodhoo KD, Liu S, Zuo X. Impact of sex disparities on the clinical manifestations in patients with systemic lupus erythematosus: a systematic review and meta-analysis. *Medicine (Baltimore)*. 2016;95:e4272. doi:10.1097/MD.0000000000004272.
26. Gold SM, Willing A, Leypoldt F, Paul F, Friese MA. Sex differences in autoimmune disorders of the central nervous system. *Semin Immunopathol*. 2019;41:177-188. doi:10.1007/s00281-018-0723-8.
27. Ysrraelit MC, Correale J. Impact of sex hormones on immune function and multiple sclerosis development. *Immunology*. 2019;156:9-22. doi:10.1111/imm.13004.

28. Japp AG, Gulati A, Cook SA, Cowie MR, Prasad SK. The diagnosis and evaluation of dilated cardiomyopathy. *J Am Coll Cardiol*. 2016;67:2996-3010. doi:10.1016/j.jacc.2016.03.590.
29. Halliday BP, Gulati A, Ali A, et al. Sex- and age-based differences in the natural history and outcome of dilated cardiomyopathy. *Eur J Heart Fail*. 2018;20:1392-1400. doi:10.1002/ejhf.1216.
30. Bybee KA, Kara T, Prasad A, et al. Systematic review: transient left ventricular apical ballooning: a syndrome that mimics ST-segment elevation myocardial infarction. *Ann Intern Med*. 2004;141:858-865. doi:10.7326/0003-4819-141-11-200412070-00010.
31. Deshmukh A, Kumar G, Pant S, Rihal C, Murugiah K, Mehta JL. Prevalence of Takotsubo cardiomyopathy in the United States. *Am Heart J*. 2012;164:66.e1-71.e1. doi:10.1016/j.ahj.2012.03.020.
32. Bairey Merz CN, Pepine CJ, Walsh MN, Fleg JL. Ischemia and no obstructive coronary artery disease (INOCA): developing evidence-based therapies and research agenda for the next decade. *Circulation*. 2017;135:1075-1092. doi:10.1161/CIRCULATIONAHA.116.024534.
33. Ibanez B, James S, Agewall S, et al. 2017 ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: the task force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018;39:119-177. doi:10.1093/eurheartj/ehx393.
34. Vanderpump MP. The epidemiology of thyroid disease. *Br Med Bull*. 2011;99:39-51. doi:10.1093/bmb/ldr030.
35. Diker-Cohen T, Duskin-Bitan H, Shimon I, et al. Disease presentation and remission rate in Graves disease treated with antithyroid drugs: is gender really a factor? *Endocr Pract*. 2019;25:43-50. doi:10.4158/EP-2018-0365.
36. Pendharkar SA, Mathew J, Petrov MS. Age- and sex-specific prevalence of diabetes associated with diseases of the exocrine pancreas: a population-based study. *Dig Liver Dis*. 2017;49:540-544. doi:10.1016/j.dld.2016.12.010.
37. Batton KA, Austin CO, Bruno KA, Burger CD, Shapiro BP, Fairweather D. Sex differences in pulmonary arterial hypertension: role of infection and autoimmunity in the pathogenesis of disease. *Biol Sex Differ*. 2018;9:15. doi:10.1186/s13293-018-0176-8.
38. Henrich JB, Viscoli CM. What do medical schools teach about women's health and gender differences? *Acad Med*. 2006;81:476-482. doi:10.1097/01.ACM.0000222268.60211.fc
39. Hochleitner M, Nachtschatt U, Siller H. How do we get gender medicine into medical education? *Health Care Women Int*. 2013;34:3-13. doi:10.1080/07399332.2012.721419.
40. Song MM, Jones BG, Casanova RA. Auditing sex- and gender-based medicine (SGBM) content in medical school curriculum: a student scholar model. *Biol Sex Differ*. 2016;7:40. doi:10.1186/s13293-016-0102-x.
41. Jenkins MR, Herrmann A, Tashjian A, et al. Sex and gender in medical education: a national student survey. *Biol Sex Differ*. 2016;7:45. doi:10.1186/s13293-016-0094-6.
42. Seeland U, Nauman AT, Cornelis A, et al. eGender-from e-Learning to e-Research: a web-based interactive knowledge-sharing platform for sex- and gender-specific medical education. *Biol Sex Differ*. 2016;7:39. doi:10.1186/s13293-016-0101-y.