ORIGINAL ARTICLE

Problem-based earning versus lecture-based learning for Gestational Diabetes Mellitus diagnosis in health care centers

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Background: Gestational diabetes mellitus (GDM) is the most common medical complication of pregnancy, resulting both maternal and fetal/neonatal negative consequences. Since health care staff in health care centers, including general practitioners and midwives encounter the condition at the first line, they should be well trained about it. This study aimed to investigate whether the problem-based learning (PBL) or the lecture-based learning (LBL) method is preferred regarding medical pedagogy.

Method: A descriptive test about GDM screening and diagnosis was given to the health care staff of 10 health care centers in Mashhad. 66 individuals with the lowest points were involved in the study in two groups of 33. The first group joined a lecture-based educational program about GDM, while the other group were trained using the PBL method. After a week, a test was given to them, and the results were compared between the two groups.

Results: The scores of the gestational diabetes diagnosis test in both groups increased significantly after the training (change from 3.50 ± 1.40 to 6.20 ± 1.51 in the PBL group, $P<0.001$; and 3.32 ± 1.64 to 5.58 ± 1.66, $P<0.001$). There was no significant difference in the results between the two groups ($P=0.13$).

Conclusion: The results of PBL educational programs about GDM are not superior to the results of the LBL method.

Keywords: Gestational diabetes, Lecture-based learning, Problem-based learning, Diabetes screening

الكسب القائم على حل المشكلات مقابل التعلم القائم على المحاضرات لتشخيص داء السكري الحملي في مراكز الرعاية الصحية

الخلفية: يعد داء السكري الحملي (GDM) من أكثر المضاعفات الطبية شيوعًا للحمل، مما يؤدي إلى عواقب سلبية على الأم والجنين/المواليد الجدد. وبما أن موظفي الرعاية الصحية في مراكز الرعاية الصحية، بما في ذلك الممارسين العامين والقابلات، يواجهون هذه الحالة في الخط الأول، فيجب تدريبهم جيدًا على ذلك. تهدف هذه الدراسة إلى معرفة ما إذا كان أسلوب التعلم القائم على حل المشكلات (PBL) أو أسلوب التعلم القائم على المحاضرة (LBL) هو المفضل فيما يتعلق بأصول التدريس الطبي.

الطريقة: تم إجراء اختبار وصفي حول فحص وتشخيص GDM لموظفي الرعاية الصحية في 10 مراكز رعاية صحية في مشهد. شارك في الدراسة 66 شخصًا حصلوا على أقل النقاط في مجموعتين من 33 شخصًا. انضمت المجموعة الأولى إلى برنامج تعليمي قائم على المحاضرات حول GDM، بينما تم تدريب المجموعة الأخرى باستخدام طريقة PBL. وبعد أسبوع، تم إجراء اختبار لهم، وتمت مقارنة النتائج بين المجموعتين.

النتائج: زادت درجات اختبار تشخيص سكري الحمل في كلا المجموعتين بشكل ملحوظ بعد التدريب (تغير من 3.50±1.40 إلى 6.20±1.51 في مجموعة PBL، P<0.001؛ و3.32±1.64 إلى 5.58±1.66، P<0.001) . لم يكن هناك اختلاف كبير في النتائج بين المجموعتين (P = 0.13).

الاستنتاج: نتائج البرامج التعليمية PBL حول GDM لا تتفوق على نتائج طريقة LBL.

الكلمات المفتاحية: سكري الحمل، التعلم المبني على المحاضرة، التعلم المبني على حل المشكلات، فحص مرض السكري

یادگیری مبتنی بر مساله در مقابل یادگیری مبتنی بر سخنرانی جهت تشخیص دیابت بارداری در مراکز بهداشت

زمینه و هدف: دیابت بارداری شایع ترین عارضه بارداری است که پیامدهای منفی مادر و جنین/نوزادی را به دنبال دارد. از آنجایی که کارکنان مراقبت های بهداشتی در خط اول با این عارضه مواجه می شوند، باید در این زمینه آموزش ببینند. امروزه، شیوه های سنتی آموزش جای خود را به شیوه های جدید دانشجو محور و فعال داده اند. مطالعه حاضر با هدف مقایسه نتایج آموزش با شیوه معمول سخنرانی در برابر شیوه جدید مبتنی بر مساله طراحی شده است.

روش: آزمونی تشریحی در مورد غربالگری و تشخیص دیابت برای پرسنل بهداشتی 10 مرکز بهداشتی درمانی شهر مشهد انجام شد. 66 نفر با کمترین نمره در دو گروه 33 نفری در مطالعه شرکت کردند. گروه اول به یک برنامه آموزشی مبتنی بر سخنرانی ملحق شدند و گروه دیگر با از روش یادگیری مبتنی بر مساله آموزش دیدند. پس از یک هفته، شرکت کنندگان آزمون دادند و نتایج بین دو گروه مقایسه شد.

یافته‌ها: نمرات تست تشخیص دیابت بارداری در هر دو گروه پس از تمرین به طور معنی داری افزایش یافت (تغییر از 3.50±1.40 به 6.20±1.51 در گروه PBL، P>0.001 و 3.32±1.64 به 5.58±1.66، P<0.001). نتایج بین دو گروه تفاوت معنی داری نداشت (P=0.13). نمرات آزمون تشخیص دیابت بارداری در هر دو گروه، بعد از مداخله آموزشی به‌طور معنی‌داری افزایش یافت (P3 <0.001)؛ اما تفاوت معنی داری در نتایج بین دو گروه مشاهده نشد (P4=0.131).

نتیجه‌گیری: برای آموزش کادر درمان، نتایج برنامه های آموزشی یادگیری مبتنی بر حل مساله نسبت به یادگیری مبتنی بر سخنرانی برتری ندارد.

واژه های کلیدی: دیابت بارداری، یادگیری مبتنی بر سخنرانی، یادگیری مبتنی بر مساله، غربالگری دیابت

صحت کی دیکھ بھال کے مراکز میں حمل ذیابیطس میلیتس کی تشخیص کے لیے مسئلہ پر مبنی کمائی بمقابلہ لیکچر پر مبنی تعلیم

پس منظر: حمل کی ذیابیطس میلیتس (GDM) حمل کی سب سے عام طبی پیچیدگی ہے، جس کے نتیجے میں زچگی اور جنین/نوزائیدہ دونوں کے منفی نتائج برآمد ہوتے ہیں۔ چونکہ صحت کی دیکھ بھال کے مراکز میں صحت کی دیکھ بھال کرنے والے عملے بشمول جنرل پریکٹیشنرز اور دائیوں کو پہلی لائن میں اس حالت کا سامنا کرنا پڑتا ہے، اس لیے انہیں اس کے بارے میں اچھی طرح سے تربیت دی جانی چاہیے۔ اس مطالعے کا مقصد یہ تحقیق کرنا ہے کہ آیا طبی تعلیم کے حوالے سے مسئلہ پر مبنی لرننگ (PBL) یا لیکچر بیسڈ لرننگ (LBL) طریقہ کو ترجیح دی جاتی ہے۔

طریقہ: مشہد میں 10 صحت کی دیکھ بھال کے مراکز کی صحت کی دیکھ بھال کے عملے کو GDM اسکریننگ اور تشخیص کے بارے میں ایک وضاحتی ٹیسٹ دیا گیا۔ سب سے کم پوائنٹس والے 66 افراد 33 کے دو گروپوں میں مطالعے میں شامل تھے۔ پہلا گروپ جی ڈی ایم کے بارے میں لیکچر پر مبنی تعلیمی پروگرام میں شامل ہوا، جب کہ دوسرے گروپ کو پی بی ایل کے طریقہ کار سے تربیت دی گئی۔ ایک ہفتے کے بعد، ان کو ایک ٹیسٹ دیا گیا، اور دونوں گروپوں کے درمیان نتائج کا موازنہ کیا گیا۔

نتائج: تربیت کے بعد دونوں گروپوں میں حمل ذیابیطس کے تشخیصی ٹیسٹ کے اسکور میں نمایاں اضافہ ہوا (PBL گروپ میں 3.50±1.40 سے 6.20±1.51 میں تبدیلی، P<0.001؛ اور 3.32±1.64 سے 5.58±1.66، P<001)۔ دونوں گروپوں (P = 0.13) کے درمیان نتائج میں کوئی خاص فرق نہیں تھا۔

نتیجہ: GDM کے بارے میں PBL تعلیمی پروگراموں کے نتائج LBL طریقہ کار کے نتائج سے بہتر نہیں ہیں۔

مطلوبہ الفاظ: حمل ذیابیطس، لیکچر پر مبنی سیکھنا، مسئلہ پر مبنی سیکھنا، ذیابیطس کی اسکریننگ

INTRODUCTION

Problem-based learning approach is a novel pedagogical method, mainly based on the self-directed learning. Dissimilar to the mainstream lecture-based learning (LBL) method, PBL outlines a method that shifts the role of teachers to the students. Accordingly, it is considered as a student-centered approach, through which the students remain actively engaged. Thus, the knowledge is not purely acquired through memorization, and active learning leading to the longer retention of knowledge occurs. Research shows that PBL provides a condition to improve clinical reasoning and problem-solving abilities amongst medical students. The PBL approach includes a discussion of the given learning topics, and the students get involved beyond their existing knowledge. Actually, the shared information is not limited to the specific references. Although the students do not experience a real-life situation, they are expected to intimately gain a vast knowledge regarding the subject (1). The approach was first suggested about 4 decades ago. Since then, it was broadly favored in the literature and the PBL-driven curricula have received comprehensive consideration. The reliability and validity of the approach have been proven (2). Nonetheless, the results of the studies assessing the advantages and disadvantages of PBL are controversial. Hence, the exact short-term and long-term efficacy are yet to be understood. A complete assessment has been hindered by the various contributing factors which directly and indirectly affect the quality and efficacy of a PBL program (3, 4). Particularly, the conflicting results are over emphasized in the field of medicine considering the importance of the association between the practical, clinical, and theoretical knowledge in regards to the medical pedagogy. According to the literature, the PBL-based curriculum is understood to be positively effective in the clinical field, while it seeks promotions and corrections so as to be effective enough in terms of the theoretical knowledge (5). In addition to the type of knowledge, the type of PBL approach may affect the results of different research studies due to the wide spectrum of approaches with varied details, which are all known as PBL (6).

Gestational diabetes mellitus (GDM) is the most common medical complication of pregnancy, through which pregnant women with no history of diabetes are diagnosed with hyperglycemia for the first time. The condition is the result of impaired glucose tolerance caused by pancreatic β-cell dysfunction. Additionally, it may be associated with chronic insulin resistance. As American researchers claimed in 2018, GDM globally occurs in 16.5% of pregnancies (7).

Early diagnosis and management of GDM, thereby preventing the complications, will not be possible unless the general practitioners and midwives who encounter the patients in the first line are not well trained about it. Recent advances in educational systems, including online learning methods and offline educational applications due to the COVID-19 pandemic are leading to improve the health care worker`s knowledge. However, choosing the best teaching method has been always a challenging topic amongst medical instructors.

In this study, aiming to investigate whether PBL or LBL is the preferred learning method in medical education, the results of training health care staff about GDM using either PBL or LBL were compared.

METHODS

After obtaining approval from the ethical committee of Mashhad University of medical sciences, some health care centers of Mashhad were randomly selected. The present researchers conducted a descriptive test which was given to health care center staff in order to determine their level of knowledge about GDM screening and management. Then, 66 of whom with the lowest points were randomly divided into two groups of 33, and they were asked to join GDM workshops or online lecture-based classes. The LBL group joined a 2-hour lecture-based class held online due to COVID19 pandemic restrictions, and offline instructional videos were provided for them. The PBL group joined 2-hour meetings two times a week in 3 separate groups of 5 and 3 groups of 6. Three leading roles were involved in each group; a chair responsible for organizing the meeting and managing the interactions amongst group members, a tutor, and a scribe responsible for recording the remarkable points. The PBL process consisted of seven main steps, including:
1. Defining and clarifying the necessary terminology;
2. Defining the issue by asking a few questions, motivating the students;
3. Brainstorming to state what the students' basic knowledge is, and which areas they lack essential information in;
4. Analyzing the evidence; in this step, the presented hypotheses were emphasized and systematically analyzed;
5. Defining learning objectives based on the results of the argument; in this step, some questions were conducted as the basis of students` self-direct learning according to their needs for studying.
6. Self-direct learning by reviewing the literature by the students, so that they could find solutions related to the learning objectives; they were asked to present their answers in the next section.
7. Reviewing the performance and giving feedback.

At the end, the students in all groups were given a week to prepare for a test, by which their new ability for screening and managing GDM was evaluated. The results of the test were compared between two groups (LBL and PBL) using Mann-Whitney and Wilcoxon test by SPSS version 25.

RESULTS

Thirty three individuals joined the lecture-based learning group, 2 of whom refused to join the final exam, and 33 individuals joined the PBL group, 3 of whom did not take the final exam; therefore, they were removed from the study population. As a result, a study population consisting of 61 health care workers from 10 different health care centers in Mashhad was evaluated in two groups of 31 (lecture-based learning) and 30 (problem-based learning). According to the results of statistical analysis by Mann-Whitney, the difference between point changes before and after the trial was not significant between the two groups (p=0.313); likewise, the

Table 1. The comparison of the points between LBL group and PBL group						
Group	**Pretest Mean Points**	**Posttest Mean Points**	**P1**	**P2**	**P3**	**P4**
PBL	3.50±1.40	6.20±1.51	0.749	0.131	<0.001	0.313
LBL	3.32±1.64	5.58±1.66			<0.001	

P1: Compared points between the two groups before the educational program based on the results of the Wilcoxon Signed Ranks Test
P2: Compared points between the two groups after educational program using statistical analysis by Mann-Whitney
P3: Compared points in each group before and after educational program based on the results of the Wilcoxon Signed Ranks Test
P4: Compared point changes before and after educational program between the two groups using statistical analysis by Mann-Whitney

Table 2. The frequency of points below 50% in 10 health care centers involved in the study	
Individuals who received points below 50% in each health care center (%)	**Health care center code**
45	1
50	2
50	3
36	4
42.8	5
40	6
83	7
60	8
100	9
50	10

post-educational-program points (p=0.131), and pre-educational-program points (p=0.749) which were not significantly different between the two groups. On the other hand, each group had received significantly higher points following the educational program than their primary points based on the results of the Wilcoxon Signed Ranks Test (PBL<0.001, LBL<0.001) (table 1). In addition, the results showed that a considerable percentage of health care staff in each health care center received points below 50%, clarifying that many of whom are not well educated about GDM screening and management (Table 2).

DISCUSSION

A recent challenge in medical education is that whether LBL is a more effective pedagogical method or PBL. LBL has been the most common learning method for years, which not only is popular in medical education, but it is also acceptable in the every area of education. On the other hand, a growing number of instructors in any fields of education are using PBL, especially regarding the medical education (8). This study aimed to compare the results of instructing GDM screening and management as an essential health issue, using both LBL and PBL methods in separate groups to investigate the best method.

In 2014, Khoshnevisasl et al. (9) conducted a study in Iran in which 40 medical students of pediatric ward of Zanjan university of medical sciences were divided into two groups; 20 of whom joined an educational course using LBL method,

and the rest of whom joined a PBL based course. At the end of the trial, the results of the final exam were compared between the two groups. Their results suggested no significant difference between the final points in neither the LBL nor the PBL group (P= 0.7). However, the mean point was higher in the PBL group. Additionally, PBL was the preferred method amongst the students according to their satisfaction survey. A considerable dissimilarity between their study and this study is that they chose different topics for each group, while the present researchers selected the same topic for both groups.

In 2018, Shi-Qing Yao et al. (10) compared the results of the LBL and PBL method in clinical practice of Chinese medicine with 162 undergraduate students, who were randomly divided into two groups of 81. After they held two different educational programs using either LBL or PBL method, they assessed the students' learning using a questionnaire and compared their points between the two groups. Unlike the present study, their results suggested that the final points in the PBL group were significantly higher (P<0.05). Similarly, the findings of Zhid et al. (11) in 2016, supported the superiority of learning by PBL compared to the traditional LBL approach.

In 2019, Changfan Wu et al. (12) compared the results of the PBL and the LBL methods regarding teaching ophthalmology contexts in 163 students, 76 of whom joined the LBL program, and 87 of whom joined the PBL program. Their findings showed superiority in the results of PBL compared to the LBL method.

The contrast between the present results and the results of the studies explained above may be related to the difference between the study populations, which was considerably greater in these studies, compared to ours. Additionally, in these studies, motivated undergraduate students with great many novel ideas and up to date knowledge were involved, while post-graduate health care staff who were dealing with their job duties, and had less energy and time for a PBL meeting were included in our study. As suggested by the evidence, the personality and demographic characteristics of the group members in PBL may notably affect the final outcomes (13).

IN 2019, Yimei Ma and Xiaoxi Lu from China (14) performed a meta-analysis to appraise the effectiveness of the PBL method in pediatric medical education. Therefore, they assessed 12 randomized clinical trials in Chinese literature; 1003 medical students were included. They compared theoretical knowledge scores, skill scores, and case analysis

scores between the students educated by either the LBL or the PBL method. Their findings indicated that PBL method is significantly more efficient in achieving better results at all parameters. However, they suggested that more clinical trials are needed to confirm their conclusion.

In 2018, a randomized clinical trial was performed in Taiwan to compare the results between LBL and PBL educational programs, aiming to improve cancer awareness among undergraduates. Their study population consisted of 323 undergraduates, 223 of whom completed the trial by joining educational programs in addition to both pretest and posttest. They divided their study population into three groups, two of them joined the PBL group, and one of them joined the LBL group. Their results showed no significant difference between the final posttest points in the first PBL group and LBL group. Moreover, they showed that the second PBL group`s points were significantly lower than the LBL group, even though they claimed that self-direct learning level has dramatically improved in both PBL groups in contrast to the LBL group (P=0.049, P=0.23) (15).

In 2020, Xin Wang et al. (16) conducted a study, in which they divided 60 residents into two groups of 30. The first group were instructed transesophageal echocardiography through web-based PBL while LBL was the selected method in the other group. They demonstrated that the PBL method was more beneficial (P<0.001).

In 2020, Yonatan Solomon (17) conducted a two-week trial. He divided 38 nursery students into two equal groups. The students were given a pretest at the initiation and a posttest after 2 hours of instruction in the LBL group and two 2-hour PBL meetings in the PBL group. The knowledge improvement in both groups was significant (p<0.001). However, the students` immediate knowledge retention seemed to be improved significantly in the LBL group (P<0.001). In line with the evidence, in 2011 Goss et al. (18) concluded that the traditional LBL method is associated by a higher average flexibility in thinking and a better memory structure than the PBL approach. The dissimilarity of his results compared to other studies may be related to the differences between immediate knowledge retention which was assessed in the study, while other research studies mainly have concentrated on long-term knowledge retention.

As described above, the results of the comparison between the LBL method and the PBL method are controversial. Although PBL seems to be a more effective method to improve self-direct learning, some research studies have suggested non-superiority of PBL against LBL. It may be the result of the various parameters affecting the quality of PBL. The quality of LBL mainly depends on the speaker`s ability to attract the students, and select the most essential points to state during the lecture. On the contrary, there are many factors gathered to determine the PBL quality, including the instructor`s questions, the students` personality, and their interpersonal communication skills; the chair`s ability to manage the meeting and providing a good review on the results of the discussion; and so on. One strength of the present study was that the same instructor for all of our PBL

groups was chosen. In addition, more than one PBL meetings was held to reduce the interrupting factors.

Moreover, some studies have demonstrated that the best teaching method is the combination of LBL and PBL. In 2020, Chun-Xiao Liu et al. (19) reviewed various randomized clinical trials to achieve the best pedagogical approach with regards to the medical education. They evaluated the clinical theoretical knowledge assessment score, clinical skills assessment score, comprehensive ability score, and teaching satisfaction amongst students under the instruction by either the PBL method or the hybrid LBL.PBL method. They concluded that the results of hybrid LBL.PBL method has been significantly better in all areas of comparison.

In order that we can achieve the best learning method to improve health knowledge, future studies should not only focus on evaluating LBL and PBL method, but also consider other learning methods, such as case-based learning (CBL), team-based learning (TBL), and research-based learning (RBL) just as Zhiwei Jiang et al. (20) did in 2021 in China. They aimed to perform a study to investigate the best learning method during the COVID-19 pandemic. They concluded that LBL and CBL were most preferred among their study population consisting of 104 undergraduate dental students and 57 residents.

In brief, the controversial results of the different studies on this topic may be related to a variety of factors, including students` different personalities (which may be unavoidable in many cases), differences amongst the abilities of the instructors and their teaching methods, different ways of organizing and managing PBL classes, and different time given to the students to prepare for the posttest exam. It is recommended that more cross-sectional studies be conducted in the future to reduce the effect of interrupting factors as far as possible. Furthermore, other learning methods such as CBL and TBL should be evaluated in addition to PBL and LBL.

CONCLUSION

Based on the results of this study, there is no doubt that the level of knowledge about GDM, as an important health issue, is not satisfying amongst the health care staff. Therefore, it is strongly recommended that educational programs be held to improve their ability of screening and management of GDM. Furthermore, the findings showed the non-inferiority of LBL method to PBL method in medical education. In addition, the poor knowledge of health care staffs compared to undergraduate students` about GDM may be related to their difficult and long work hours, which needs to be reviewed by the health ministers.

Ethical Considerations
Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors. This study was approved by the ethical committee of Mashhad University of Medical Sciences, Mashhad, Iran. Ethical approval number: IR.MUMS.REC.1399.114.

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