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Item Analysis of Medicine Multiple Choice Questions (MCQs) for Under Graduate (3rd year MBBS) Students.

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ABSTRACT

In past two decade lot of improvisation is going on in teaching, learning and assessment methodology, to maintain the international standards and competence in medical education. To assess post test validation of multiple choice question (MCQ) as an assessment tool by item analysis in MBBS 3rd year students for subject of Medicine by calculating Difficulty index (DIF–I), Discrimination index (DI) and Distractor effectiveness (DE) and also to modify /store or discard MCQs so as to develop a bank of valid MCQs. The study was conducted in the department of Medicine. A hundred third-year MBBS students were participated in the MCQs test comprising of hundred questions with single best response. We analysed 100 items (MCQs) and 300 distractors. Pre-validation of the paper was done. Post validation of the paper was done by item analysis. Each item was analysed for Difficulty Index (DIF- I) or Facility value or p value using, Discrimination index (DI) or d value using the formula and Distractor Effectiveness (DE) or functionality. The mean and standard deviation for Dificulty index (DIF- I) (%), Discrimination index (DI) and Distractor eficiency (DE) (%) were 48.90269 (±13.72571%), 0.190448 (±0.135954) and 82.8 (15.6%) respectively. Of total 100 items 24 had Discrimination index (DI)/'d' <0.2 (poor), 45 had DI ≥0.20 & ≤0.35 (good) and 31 had DI >0.35 (excellent). Of total 100 items, 35 had Difficulty Index (DIF- I) 30-70% (acceptable MCQs), 25 had DIF-I 50-60% (ideal MCQs), 22 had DIF-I <30 % (too difficult, which can be revised and or discarded) and 18 had DIF-I >70% (too easy which can be revised / modified). Of total 100 items 24 had Discrimination index (DI)/'d' <0.2 (poor DI, require to revise or discard), 45 had DI ≥0.20 & ≤0.35 (good DI, can be stored for MCQ bank) and 31 had DI >0.35 (excellent DI, can be stored for MCQ bank). According to DIF-I total 60 items and by DI total 76 Items can be stored with good-excellent DIF-I and DI value respectively. According to DIF-I 40 and DI 24 items should be revised, modified, and or discarded. Total 100 items had 300 distractors of them 263 (87.66%) were functional distractors (Items with 0 NFD (DE=100%). Total 37 (14.06%) were nonfunctional distractors (NFD). Total 24 items were with one or two non-functional distractors. Total 11 items had one NFD (DE=33.3%) and 13 items had two NFD (DE=66.6%). We concluded that items having average DIF-I and high DI with functional distractors should be incorporated in to the set of MCQs. Results of DIF-I, DI and DE should be interpreted in the light of interrelationship of the varios indices, level, standard of students and their preparation or preparedness of subject before MCQ examination. Post validation of item analysis is important to build healthy MCQs bank for various objective examinations.

Keywords: Item analysis, Discrimination index, Discrimination index, Distractor effectiveness, non-functional distractors

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INTRODUCTION

As an academician it is mandatory for teachers to upgrade their knowledge of teaching, learning and assessment methods, as traditional methods of assessment of medical graduates and postgraduates has their own pros and cons. There is an increasing tendency to use multiple choice question (MCQ) as an evaluation and assessment tool of performance and competence tool in various graduate and post-graduate entrance examinations. Designing good MCQs is a complex, challenging and time consuming process.[1] Constructed and assessed, MCQs need to be tested for the standard or quality. Item analysis examines the student responses to individual test items (MCQs) to assess the quality of those items and test as a whole. Item analysis assesses the assessment tool for the benefit of both student and teacher. MCQs emphasize recall of factual information rather than conceptual understanding and interpretation of concepts. Properly constructed MCQs can assess higher cognitive processing of Bloom's taxonomy such as interpretation, synthesis and application of knowledge, instead of just testing recall of isolated facts.[2] Item analysis is largely used for creating a valid standard MCQ (item) question bank in various medical universities. Item analysis is one way of validating, quality of MCQs so as to assess class performance as a part of formative assessment in medical undergraduates and pre-PG medical entrance examination. Item analysis helps tremendously to achieve better teaching, better learning and segregate high, mid and low achiever students. The MCQs to be used must be of quality which depends upon its difficulty index (DIF -I), discrimination index (DI) and distractor efficiency (DE).[1, 2, 3] So far there are scanty published studies on item (MCQs) analysis. The present study was conducted to assess post test validation of multiple choice question (MCQ) as an assessment tool for MBBS graduate students in subject of Medicine to develop a pool of valid MCQs by assessing them with Difficulty index (DIF –I), Discrimination index (DI) and Distractor effectiveness (DE) and also to modify accept or discard MCQs according to results.

MATERIAL AND METHODS

The study was conducted in the department of Medicine for assessment. A hundred third-year MBBS students were participated in the MCQs test comprising of hundred questions with single best response and one mark for each correct answer. There was no negative marking. This was an analytic study conducted at Krishna Institute of Medical Sciences Deemed University (KIMSDU), Karad after institutions ethical committee approval. We studied and analysed 100 items (MCQs) and 300 distractors. The time allotted was one and half hour. Pre-validation of the paper was done by the Medicine department faculty teachers. The MCQs were chosen so as to cover particular system of importance and subject as a whole in medicine and which were included roughly 60% must know, 20% desired to know and 20% nice to know MCQs from the standard syllabus. The easy items were placed at the start of the test as 'warm-up' questions. The difficult items reviewed for possible confusing language, areas of controversies, or even an incorrect key and 100 items of MCQs were selected. To avoid possible copying from neighboring student, three sets of coded MCQs were prepared with different sequence of MCQs. Evaluation was done out of hundred marks and 50% score was the passing mark. Post validation of the paper was done by item analysis. The scores of all the students were arranged in order of merit. The upper one third students were considered as high achievers and lower third as low achievers. Each item was analysed for:[3]

- Difficulty Index (DIF- I) or Facility value or p value using the formula p = H + L / N ×100 [H= number of students answering the item correctly in the high achieving group L= number of students answering the item correctly in the low achieving group N= Total number of students in the two groups (including non-responders)]
- Discrimination index (DI) or d value using the formula d= H-L× 2/N.
- Distractor Effectiveness (DE) or Functionality

DIF-I describe the percentage of students who answered the item correctly and ranges between 0 and 100%. DIF I is a misnomer as bigger is the value of DIF I, easier is the item and vice versa; hence, it is also called by some authors as ease index. DI is the ability of an item to differentiate between students of higher and lower abilities and ranges between 0 and 1. Higher the value of DI, item is more able to discriminate between students of higher and lower abilities. DI of 1 is ideal as it refers to an item which perfectly discriminates between students of lower and higher abilities. There are instances when the value of DI can be <0 (negative DI) which simply means that the students of lower ability answer more correctly than those with higher ability.

Here a student of lower ability by guess select correct response; while a good student suspicious of an easy question, takes harder path to solve and end up to be less successful.[4]

Interpretation:

1. Difficulty index (DIF-I) is merely the proportion of total students in the two groups who have answered the item correctly. The items with a p value between 30 – 70% were considered as acceptable. Amongst these, items with p value between 50-60% were ideal. Items with p value less than 30% (too difficult) and more than 70% (too easy) were considered for either modification or rejection.
2. The Discrimination index (DI or d), also called point biserial correlation is a measure of the item to discriminate between students of higher and lower abilities and ranges between 0 and 1. The d value between 0.20 and 0.35 was considered as good. Items with DI more than 0.35 was considered as excellent and those with DI less than 0.20 were considered as poor.
3. An item contains a stem and four options including one correct (key) and three incorrect (distractor) alternatives. If an item contains three or two or one or nil NFDs then DE would be 0, 33.3%, 66.6% and 100% respectively.[4]
4. NFD in an item is option (s) (other than key) selected by <5% of students;
5. Functional or effective distractors are those selected by 5% or more participants.
6. Items were categorized as poor, good, or excellent and actions such as discard/revise and store were proposed based on the values of DIF-I and DI as suggested.[5] [Table no.1]

Statistical analysis

Data was entered and analyzed in MS Excel 2007 and simple proportions, mean, standard deviations, coefficient of variation were calculated and chi-square test was applied and 'p' value < 0.05 was considered as statistically significant. Data obtained was entered in Microsoft Excel 2007 and analyzed. Score of 100 students was entered in descending order and whole group was divided in three groups. One group consisting of higher marks was considered as higher ability (H) and other group consisting of lower marks was considered as lower ability (L) group. Out of 100 students, 33 were in H group and 33 in L group; rests (34) were in middle group.[6, 7, 8]

Table 1: Cutoffs and formulae Item analysis Index

1. High achievers (H)	Top one third			
2. Low achievers (L)	Bottom one third			
3. Difficulty Index (DIF- I) or Facility value or 'p' value (0-100%)	30-70% Acceptable	50-60% Ideal	<30% Too difficult	>70% Too easy
p = H+L/N ×100 [H= number of students answering the item correctly in the high achieving group L= number of students answering the item correctly in the low achieving group N= Total number of students in the two groups (including non-responders)]				
Discrimination (DI) index 'd'	0.2-0.35: Acceptable	>0.35: Excellent	<0.2: Poor	
d= H-L× 2/N				
There are instances when the value of DI can be <0 (negative DI) which simply means that the students of lower ability answer more correctly than those with higher ability.				
Nonfunctional distractor (NFD): Attempted by less than 5% students				
Functional or effective distractors (DE): Attempted by more than 5% students				
If an item contains three or two or one or nil NFDs then DE would be 0, 33.3%, 66.6% and 100% respectively.				

RESULTS

Total 100 items (MCQs) from subject of medicine with 300 distracors in 100 3rd year MBBS students were studied according to the standard protocol previously laid down. Total 100 items were categorized and chosen according to must know (60%), desired to know (20%) and nice to know (20%). All data of 100 student and 100 items with key answer and distractors were entered in Microsoft Excel data sheet and analysed by available formulae in Excel sheet and interpreted accordingly for difficulty index (DIF-I) in percentage,

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Discrimination index (DI), Distractor efficiency (DE) in percentage were calculated. Mean, standard deviation and 'p' valves were calculated for numerical variables. Total 100 students were divided in three groups as high achievers (33), low achievers (33) and in between high and low achievers (34). Of total 100 items, 35 had Difficulty Index (DIF- I) or 'p' 30-70% (acceptable MCQs), 25 had DIF-I 50-60% (ideal MCQs), 22 had DIF-I <30 % (difficult) and 18 had DIF-I >70% (easy). The overall mean for Difficulty Index (DIF- I) or 'p' value was 48.90269 (±13.72571). Of total 100 items 24 had Discrimination index (DI)/ 'd' <0.2 (poor), 45 had DI ≥0.20 & ≤0.35 (good) and 31 had DI >0.35 (excellent). [Table no. 2]

Table 2: Profile of item ananlysis and indices

Variables of item analysis (n=100)	**Mean**	**SD(±)**
1. High achievers (H) (n=33)	23.44	5.303553
2. Low achievers (L) (n=33)	17.06	6.333844
A. 'p' [Difficulty Index (DIF- I) or 'p' value (0-100%)]	48.90269	13.72571
1. 30-70%: Acceptable	35 (22%)	
2. 50-60%: Ideal	25 (25%)	
3. <30%: Too difficult	22 (35%)	
4. >70%: Too easy	18 (18%)	
B. Discrimination (DI) index 'd' = 0.2-0.35: Acceptable	0.190448	0.135954
1. <0.20: poor	24	
2. ≥0.20 & ≤0.35: good	45	
3. >0.35: excellent	31	

The mean and standard deviation for Dificulty index (DIF- I) (%), Discrimination index (DI) and Distractor eficiency (DE) (%) was 48.90269(±13.72571%), 0.190448 (±0.135954) and 82.8 (15.6%) respectively. [Table no. 3]

Table 3: Various indices of item analysis

Parameter/ Indices (n=100)	**Mean**	**Standard deviation (SD)**
Dificulty index (DIF- I) (%)	48.90269	13.72571%
Discrimination index (DI)	0.190448	0.135954
Distractor eficiency (DE) (%)	82.8%	15.6%

Of total 100 items, 35 had Difficulty Index (DIF- I) 30-70% (acceptable MCQs and can be stored for MCQ bank), 25 had DIF-I 50-60% (ideal MCQs and can be stored for MCQ bank), 22 had DIF-I <30 % (too difficult, which can be revised and reintroduced for next examination or discard) and 18 had DIF-I >70% (too easy which can be revised / modified and reintroduced or discarded). Of total 100 items 24 had Discrimination index (DI)/'d' <0.2 (poor DI, require to revise or discard), 45 had DI ≥0.20 & ≤0.35 (good DI, can be stored for MCQ bank) and 31 had DI >0.35 (excellent DI, can be stored for MCQ bank). According to DIF-I total 60 items and by DI total 76 Items can be stored for MCQ bank with good-excellent DIF-I and DI value respectively. Discrimination index DI discriminate between higher and lower achiever in present analysis there was no negative value for DI. According to DIF-I 40 items and DI 24 items should be revised, modified, reintroduced and or discarded. [Table no. 4 & 5]

Table 4: Difficulty index in item analysis

Difficulty index (DIF I) (n=100 items)				
<30%: Too difficult	22	22	Difficult	Revise/discard
50-60%: Ideal	25	35	Good	Store
30-70%: Acceptable	35	25	Excellent	store
>70%: Too easy	18	8	Easy	Revise/discard

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Table 5: Discrimination index (DI) in item analysis

Discrimination index (DI) (n=100 items)				
<0.20 (poor)	24	24	Poor	Revise/discard
≥0.20 & ≤0.35 (good)	45	45	Good	Store
>0.35 (excellent)	31	31	Excellent	Store

Total 100 items had 300 distractors of them 263 (87.66%) were functional distractors (Items with 0 NFD (DE=100%). Total 37 (14.06%) were nonfunctional distractors (NFD). Total 24 items were with one or two non-functional distractors. Total 11 items had one NFD (DE=33.3%) and 13 items had two NFD (DE=66.6%) [Graph no.1& Table no. 6]

Graph 1: Variables of item analysis and distracters

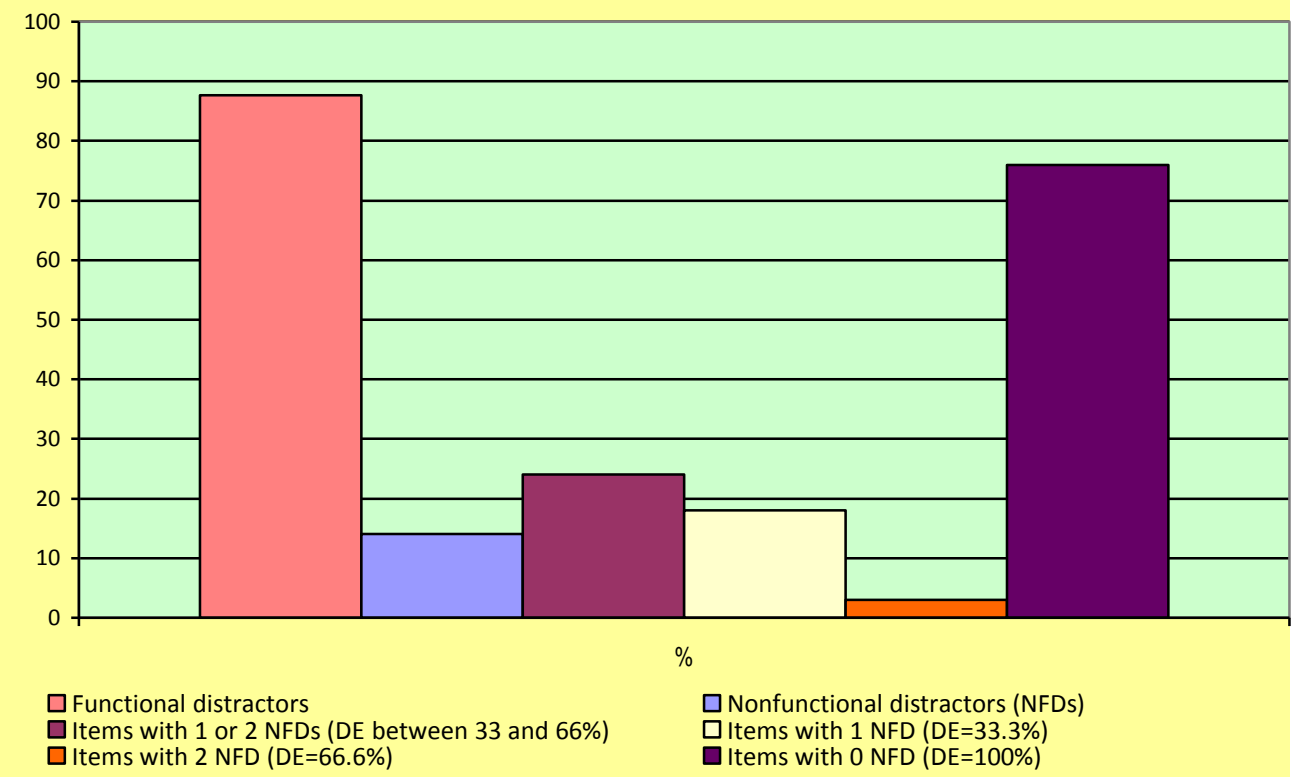

Table 6: Variables of item analysis and distractors

Variable of Items and their distractors	Total
1. Number of items	100
2. Total distracters	300
3. Functional distractors	263 (87.66%)
4. Nonfunctional distractors (NFDs)	37 (14.06%)
5. Items with 1 or 2 NFDs (DE between 33 and 66%)	24
6. Items with 1 NFD (DE=33.3%)	11
7. Items with 2 NFD (DE=66.6%)	13
8. Items with 0 NFD (DE=100%)	76
9. Overall mean DE (mean±SD)	82.8% (±15.6%)

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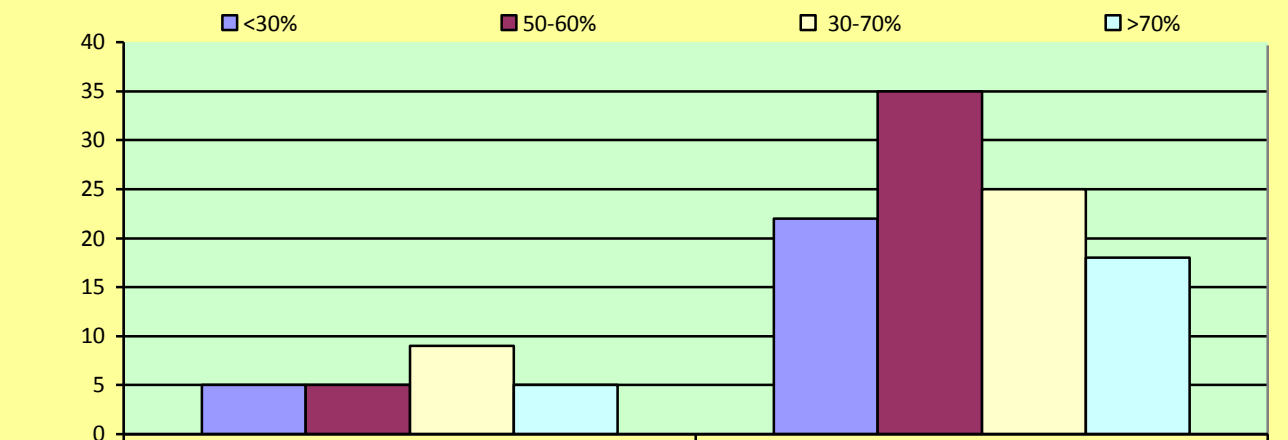
Table 7: Correlation of Difficulty index and discrimination index to non functional distractors

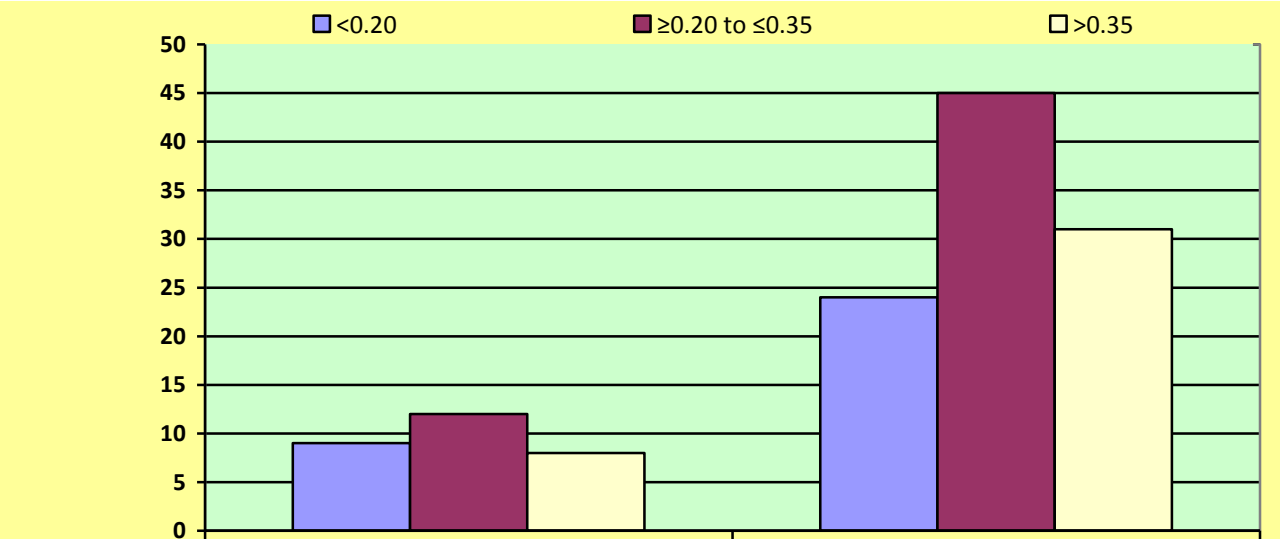
DIF- I (%)	NFDs	(n=100)	DI	NFDs	(n=100)
<30%	5	22	<0.20	9	24
50-60%	5	25	≥0.20 to ≤0.35	12	45
30-70%	9	35	>0.35	8	31
>70%	5	18	-	-	-

Graph 2: Correlation of Difficulty index (DIF-I) to nonfunctional distracter (NFD)



	Items with NFDs	DIF- I (%)
<30%	5	22
50-60%	5	35
30-70%	9	25
>70%	5	18

Graph 3: Correlation of discrimination index (DI) to nonfunctional distracter (NFD)



	Items with NFDs	DI
<0.20	9	24
≥0.20 to ≤0.35	12	45
>0.35	8	31

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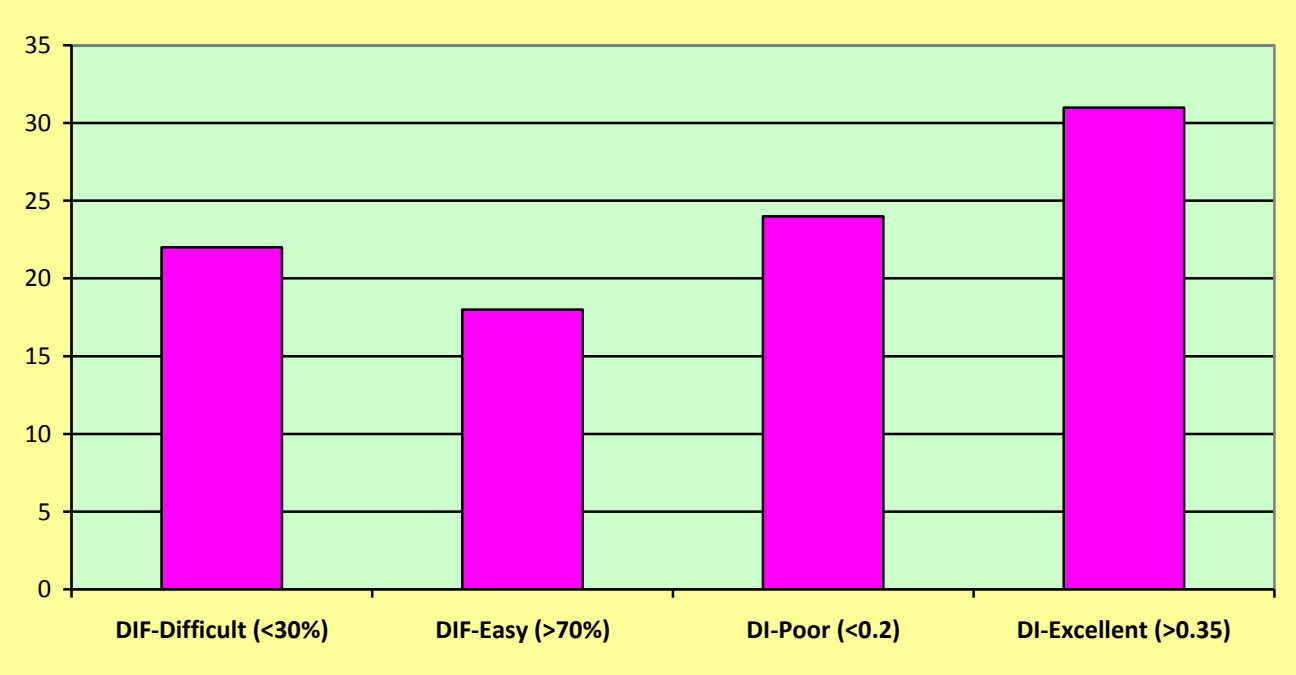
Total 5 items out of 22 items with Difficulty index (DIF-I) < 30% had non-functional distractors, 5 items out of 25 items with DIF-I < 50-60% had non-functional distractors, 9 items out of 35 items with DIF-I < 30-70% had non-functional distractors and 5 items out of 18 items with DIF-I >70% had non-functional distractors. Total 9 items out of 24 items with discrimination index (DI) <0.20 had non-functional distractors, 12 items out of 45 items with discrimination index (DI) ≥0.20 to ≤0.35 had non-functional distractors and 8 items out of 31 items with discrimination index (DI) >0.35 had non-functional distractors. [Table no. 7 and Graph no. 2 & 3] There was significant statistical difference between too difficult items and too easy items for distractor effectiveness by Difficulty index (DIF-I) with 'p' = 0.045959257. There was no significant difference for distracor effectiveness between poor and excellent items by Discrimination index (DI) with 'p' = 0.54. Total 24 items with NFDs had mean values of DIF-I and DI as (71.5% ±11.6%) and 0.16, respectively. Remaining 76 items without NFDs had lower mean values for DIF I and DI as 37.6% and 0.112, respectively. When viewed in relation of difficulty level of questions, DE was high (87.5%) in 22 difficult items than 68.9% in 18 easy items ['p' 0.045959257]. Mean DE was (77.8±16.4) in 31 items with excellent DI compared to (68.4±13.7) in 24 items with poor DI; difference in DE in both cases was statistically not significant. DE showed little variation amongst items with changing DI ['p' = 0.54]. [Table no.8 and Graph no.4]

Table 8: Showing comparison of DI and DIF-I

Grading	Difficulty index (DIF I)		Discrimination index (DI)	
	Difficult: <30%	Easy :>70%	Poor :<0.2	Excellent : >0.35
No of items (n=100)	22	18	24	31
DE (%) mean±SD	(72.8% ±13.6)	(69.3±10.5)	(68.4±13.7)	(77.8±16.4)
'p'	= 0.045959257		= 0.54	

Graph 4: Showing comparison of DI and DIF-I



In present item analysis 22 students scored below average marks and 78 students scored average or above average marks lowest was 29 marks and highest was 81 marks. [Graph no. 5]

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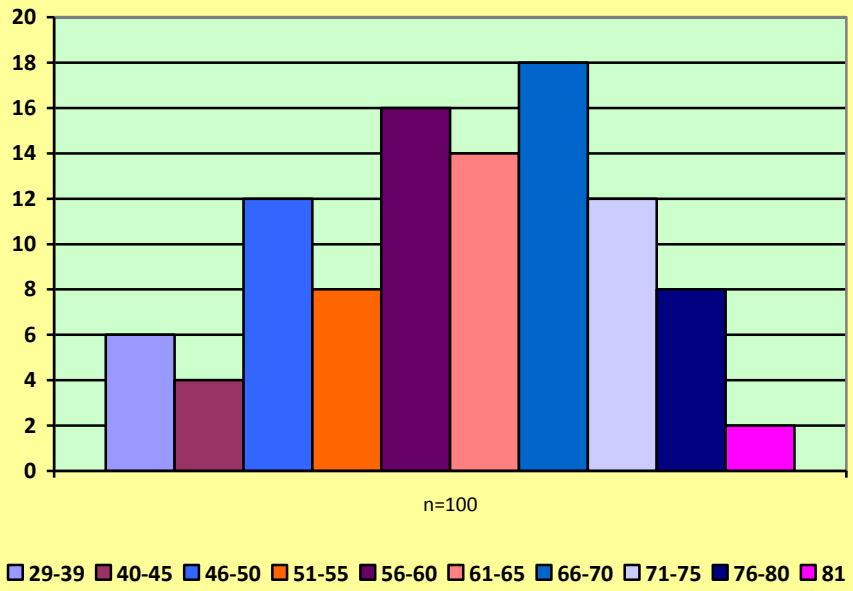
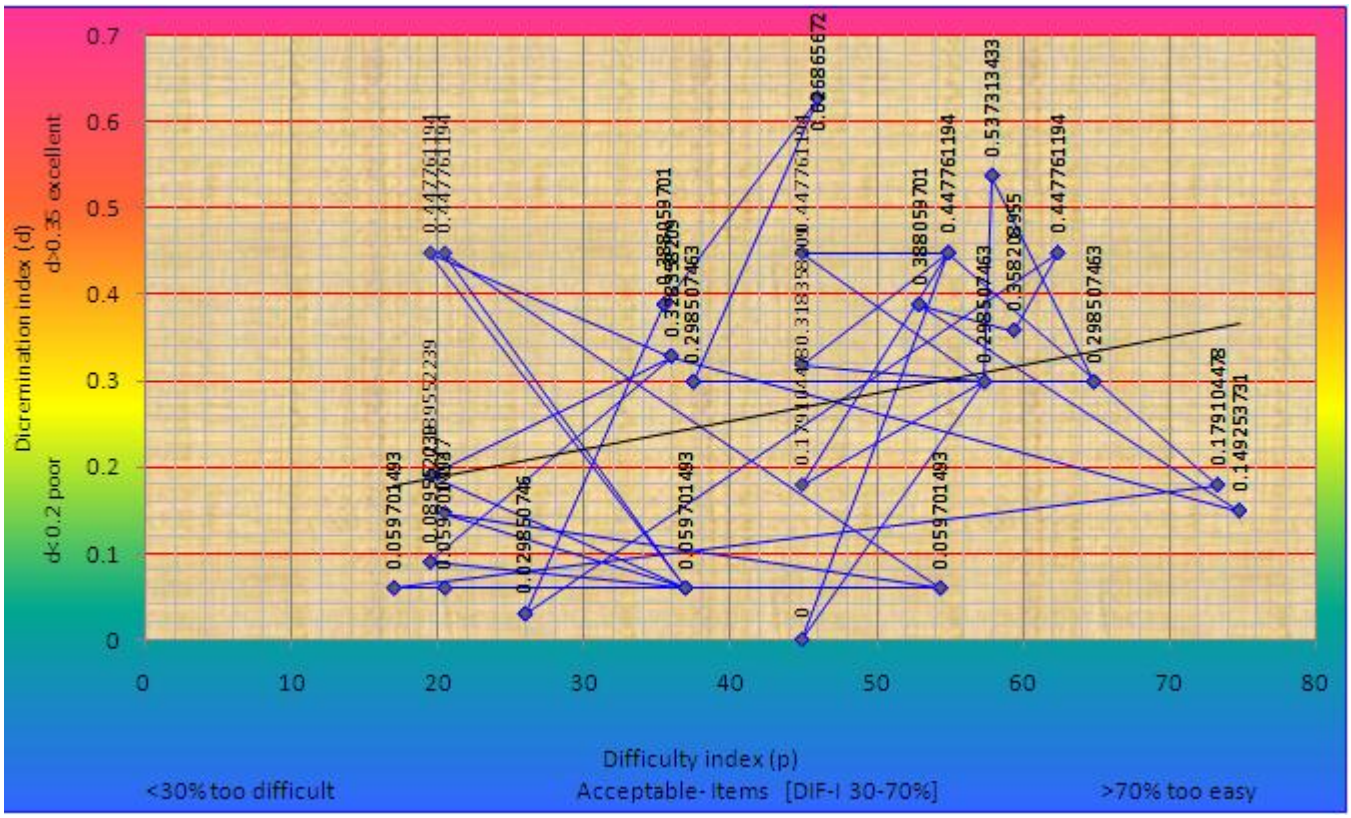
Graph 5: Showing distribution of marks obtained by 100 students out of 100 marks

Marks obtained out of 100	n =100 students
29-39	6
40-45	4
46-50	12
51-55	8
56-60	16
61-65	14
66-70	18
71-75	12
76-80	8
81	2
29-81	100



The DIF-I between 30-70% items had better and acceptable (good to excellent) DI value and DIF-I < 30% and > 70% had poor DI value ('p'< 0.01). [Graph no.6]

Graph 6: Showing correlation of DIF-I and DI



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DISCUSSION

A good Multiple choice questions (item) can assess cognitive, affective, as well as psychomotor domain and is preferred over other methods for its objectivity comparability, wide coverage of subject, and minimization of assessor's bias. Item analysis is valuable procedure performed after the examination providing information regarding the reliability and validity of an item/test by calculating DIF- I, DI, and DE and their interrelationship. An ideal item (MCQ) was the one which has average difficulty (DIF I between 31 and 60%), high discrimination (DI ≥ 0.25) and maximum DE (100%) with three functional distractors. We compared our results with published studies in spite of all limitations in the view of different sets of items, difference in preparedness of students, different level of standard of student and different subject items. Gyata Mehta et al studied item analysis in 100 First-year MBBS students for MCQs test comprising of fifty questions in subject of Anatomy and identified the low achievers and their learning difficulties. Difficulty index of 31(62%) items was in the acceptable range (p value 30-70%), 16(32%) items were too easy (p value >70%) and 3(6%) items were too difficult (p value <30%). Discrimination index of 26 (52%) items was excellent (d value>0.35), 9(18%) items was good (d value 0.20-0.34) and 15(30%) items were poor (d value<0.2%). A total of fifty items had 150 distractors of these, 53(35.3%) were nonfunctional distractors, 38(18.6%) were functional distractors.[6] These findings are comparable with our results, in which 60% items had acceptable range of DIF-I and 76% had good to excellent DI value with only 14.06% NFD in 24 items. Gajjar S et al studied items (MCQs) by assessing with DIF I, DI and DE, in an internal examination in Community Medicine of 148 students. Total 50 MCQs or items and 150 distractors were analyzed. Out of 50 items, 24 had "good to excellent" DIF I (31 - 60%) and 15 had "good to excellent" DI (> 0.25). Mean DE was 88.6% considered as ideal/ acceptable and non functional distractors (NFD) were only 11.4%.[4] Similarly in our cohort of 100 students with 100 items with 300 distractors were studied with total 24% items with NFD and remaining 76% items were with functional distracters. Total 60% of items had acceptable DIF-I and 76% items were good to excellent DI in present study. Gajjar S et al quoted mean DI was 0.14. Poor DI (< 0.15) with negative DI in 10 items and 15 items with 17 NFDs, while rest items did not have any NFD with mean DE of 100%. Items analyzed in the study were neither too easy nor too difficult (mean DIF-I = 39.4%) which is acceptable but the overall DI was 0.14. Therefore, items were acceptably difficult but were not good at differentiating higher and lower ability students. DI was poor due to the 10 items with negative DI.[4] Similarly in present study total 37 NFD in 24 items with no negative DI with mean DIF-I, DI and DE was 48.90269(±13.72571%), 0.190448 (±0.135954) and 82.8 (15.6%) respectively. Guilbert JJ et al quoted mean DIF I in their study was 39.4 ± 21.4% well within the acceptable range (31-60%). Too difficult items (DIF I ≤ 30%) will lead to deflated scores, while the easy items (DIF I > 60%) will result into to inflated scores and a decline in motivation.[3] Similarly in our study the mean and standard deviation for DIF- I (%) and DI was 48.90269(±13.72571%) and 0.190448 (±0.135954) respectively. Singh JP et al (2014) studied item analysis for 20 MCQs and 60 distractors, in department of Community Medicine, in 82 third year MBBS students. Post validation of the paper was done by item analysis. Difficulty index of 11(55%) items was in the acceptable range (p value 30-70%), 9(45%) items were too easy (p value >70%) and no any items were too difficult (p value <30%). Discrimination index of 10 (50%) items was excellent (d value>0.35), 4(20%) items was good (d value 0.20-0.34) and 6(30%) items were poor (d value<0.2%). They concluded that, Difficulty Index (p) and Discrimination Index (DI) were nice tools for the assessment of the quality of an MCQ item and to assess class performance. Similarly in our study 22 % items were easy and 18 % items were difficult remaining 60% items were in acceptable range (30-70%). According to DIF-I total 60 items and by DI total 76 Items can be stored with good-excellent DIF-I and DI value respectively. In our study DI was poor in 24% items, good in 45 items and excellent in31% items. According to DIF-I 40 items and DI 24 items were considered for revision, modification, and or discarded or reintroduced after desired modification. [9] Pande SS et al analysed 240 MCQs (items), in 100 students for level of difficulty and discrimination index. They quoted a wide distribution of item difficulty indices (8.57 to 95.71) and discrimination indices (-0.54 to 0.8). [10] These findings are different than our observation in which, mean and standard deviation for Difficulty index (DIF- I%), Discrimination index (DI) and Distractor eficiency (DE) (%) was 48.90269(±13.72571%), 0.190448 (±0.135954) and 82.8 (15.6%) respectively. This could be due to differences in the less numbers of item (100) analysed different sets of MCQs and different preparedness of students in our cohort. Pande SS et al quoted mean for difficulty index was 52.53 and discrimination index was 0.30. On average, about 23% of the MCQ items were easy (P >70%), while about 15% were difficult (P <30%). The remaining 62% items were within acceptable range (30 to 70%). The majority (75%) of the items was acceptable as far as difficulty and discriminative indices were concerned.[10] Similarly in our study 22 % items were easy and 18 % items were difficult remaining 60% items were in acceptable range (30-70%). According to DIF-I total 60 items and by DI total 76 Items can be stored with good-excellent DIF-I and DI value respectively. According to DIF-I 40 items

and DI 24 items should be revised, modified, reintroduced and or discarded. Pande SS et al stated that, moderately easy/difficult items had maximal discriminative ability. [10] Too easy and too difficult items gave poor discrimination index. Negative discrimination was observed in only 4% of the items indicating faulty items or incorrect keys, these findings are comparable with our results though we had no item with negative discrimination index. After correlating all the indices of item analysis we decided to modify and reintroduce 13 items out of 100 and 7 were discarded due to poor discrimination index, too easy items with less DE.

CONCLUSIONS

Item analysis is largely used for creating a valid standard MCQ (item) question bank in various medical universities. Item analysis is one way of validating, quality of MCQs so as to assess performance and competence as a part of formative assessment in medical undergraduates and pre-PG medical entrance examination. We concluded that items having average difficulty DIF-I) and high discriminating power (DI) with functional distracters (DE) should be incorporated in to the set of MCQs. The item should be considered for modification to get difficulty level and discrimination power within acceptable range before it can be included in standard MCQ bank. Item analysis helps tremendously to achieve better teaching, better learning and segregate high, mid and low achiever students. Post validation of item analysis is important to build healthy MCQs bank for various formative examinations. Results of DIF-I, DI and DE should be interpreted in the light of level, standards of students and their preparation or preparedness of subject before MCQ examination in the study. All the indices (DIF-I, DI and DE) of item analysis should be interpreted together than individual while making decision of storing or discarding MCQs carefully. To get a standard range and cutoffs of DIF-I, DI and DE receiver operating characteristic curve (ROC) should be utilised for different students of various institutes. Overall functionality of effective distactor is a key in developing quality MCQs.

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