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Neuroscience-Based Nomenclature as a Teaching Tool, Introduction and pilot study

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Corresponding Author:	Joseph Zohar, MD Sheba Medical Center at Tel Hashomer: Sheba Medical Center ISRAEL
Corresponding Author E-Mail:	jozohar@gmail.com
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	Sheba Medical Center at Tel Hashomer: Sheba Medical Center
Corresponding Author's Secondary Institution:	
First Author:	sasson zemach, MD
First Author Secondary Information:	
Order of Authors:	sasson zemach, MD
	daniel Minkin-Levy, MD
	Joseph Zohar, MD
Order of Authors Secondary Information:	
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Neuroscience-Based Nomenclature as a Teaching Tool,

Introduction and pilot study

Sasson Zemach, MD	The Jerusalem Mental Health Center, Israel
Daniel Minkin Levy, MD	The Jerusalem Mental Health Center, Israel
Joseph Zohar, MD **Corresponding Author** **joseph.zohar@sheba.health.gov.il**	Department of Psychiatry, Sheba Medical Center, Tel-Hashomer, and Sackler School of Medicine, Tel Aviv University, Israel.

Abstract

Neuroscience Based Nomenclature (NbN) is a pharmacologically-driven nomenclature that aims to replace the current disease-based nomenclature. Focusing on pharmacology and mode-of-action, the use of NbN encourages scientifically-minded prescribing . NbN also might be used as a teaching tool as it presents the depth and richness of the neuroscience fabric of psychotropics. We present a pilot sudy, examining the effect of using NbN during the rotaion of medical students in psychiatry.

Study population & setting: Fifty-six Israeli medical students during clerkship in psychiatry, divided into a control group (n=20), taught psychopharmacology the traditional way, and an intervention group (n=36) introduced to the NbN concept.

Methods: Students in both groups filled out identical questionnaires at the beginning and end of the clerkship, including questions of knowledge on psychopharmacology, views on current terminology and interest in a psychiatric residency.

Results: Comparing the average change in scorings (delta of post-pre) for each item in intervention vs. control questionnaires, the intervention group showed a significantly larger, positive delta in 6 out of 10 items than the control group. Mean scores did not differ significantly between the two groups in the pre-questionnaires. However, significantly higher scores were shown for the intervention group while conducting within and between-group comparisons.

Conclusion: NbN as a teaching tool was associated with a better educational experience , deeper understanding about psychotropics and increased interest in a psychiatric residency.

Keywords: psychopharmacology; psychiatry, Nomenclature, student views.

1. Introduction

A recent survey of Health Care Professionals (HCPs) revealed that the current labeling of drugs as "atypical antipsychotics" hinders optimal care (Mehul et al, 2020). Despite the well-established utility of "antipsychotics" in various mental disorders (Taylor et al, 2020, Pringsheim et al, 2019, Brakoulias, 2019), 33% of HCPs rarely mention the term "atypical antipsychotics" to patients. Half of the clinicians who use this term believe it makes their patients feel nervous, confused, or more severely ill, while half of the patients said this term delays their acceptance of treatment. As a result, most HCPs support changing the current nomenclature of psychotropics to an alternate naming system that will be easier to introduce and discuss.

In teaching psychopharmacology, we use the current nomenclature, which is comprised of disease-based classes: antipsychotic, antidepressant, mood stabilizer, stimulant, anxiolytic, hypnotic ect. This naming system does not reflect the wealth of current neuroscientific knowledge. In the 1950s, when the therapeutic benefits of chlorpromazine and imipramine were discovered in psychosis and depression, respectively, they were subsequently classified as "antipsychotic" and "antidepressant" medications. As there were only a few psychotropics at the time there was no need for a more complex nomenclature. However, this classification became rapidly obsolete, as it has been observed that many of these medications were effective for more than one disorder.

Some psychiatrists consider the outdated concepts used in the contemporary pharmacologic "language" an inevitable contributor to the psychiatric profession's prejudice, portraying it as stagnant and unevolved (Zohar et al 2014) This prejudice is not without consequences, as in recent decades, the population of practicing psychiatrists seems to be in decline (Bishop et al, 2016). One of the factors responsible for this trend is medical student’s perception that the

scientific foundation of psychiatry and psychopharmacology is weaker than other medical fields (Feifel et al, 1999, Russo et al 2020). Part of this might be attributed to the current nomenclature, nomenclature in which the names we use do not often match their clinical use (and indications), nor the contemporary knowledge and updated concepts.

Neuroscience based Nomenclature (NbN) is a new, scientifically driven classification systemdesiged to replace the current terminology for psychiatric medications. It is a multiorganization, non-profit initiative led by the ECNP (European College of Neuropsychopharmacology) and fellow organizations (American College of Neuropsychopharmacology, Asian College of Neuropsychopharmacology, International College of Neuropsychopharmacology and International Union of Basic and Clinical Pharmacology). NbN includes two main building blocks – Pharmacology Domain (PD) and Mode of Action (MOA) Domain. Pharmacology domain referes to the neural system that is being mudulated by the drug (e.g. dopamine, serotonin, glutamate) while the mode of action represent the mechanism by which the drug acts (e.g. reuptake inhibitor, partial agonist, agonist, antagonist), there are currently 10 pharamacology domains and 9 modes of actions that can be felexibly attributed to any drug currently used in psychiatry. Hence, according to NbN, olanzapine should no longer be referred to as an "antipsychotic", but as a dopamine, serotonine (PD) antagonist (MOA), and sertraline should no longer be called an "antidepressant", but a serotonin (PD) reuptake inhibitor (MOA).

(Tables 1, 2 – see tables document)

The integration of NbN into clinical practice is promoted by using a free of charge mobile app. The app is a clinical decision making aid, providing useful information that is beyond the scope

of the terminology itself (information on Dosing, Approved indications, Efficacy & Side Effects, Practical notes, Pregnancy safety, and Neurobiolog).

We expect that the paradigm shift in psychotropics' naming, the expansion of our vocabulary while describing psychotropics, and the useful app would enable medical students to be more informed when prescribing and writing clinical/scientific presentations. Moreover (and not less important), it would expose medical students to the rich scientific base behind pharmacotherapy, thus upgrading their confidence in the scientific basis of psychiatry.

Despite receiving wide international recognition by leading peer review journals (Zohar & Kasper, 2016, Gordwood et al 2017, Krystal et al, 2016, Möller et al, 2016), national psychiatric associations and important publications, research on the influence of NbN in clinical and teaching settings is lacking. This paper introduces the results of a pilot study conducted on Israeli medical students during their psychiatry clerkship.

2. Experimental procedures:

Objective

The primary objective was to examine the effects of introducing Neuroscience-based Nomenclature (NbN) on medical students' views about psychopharmacology and psychiatry in general via a position questionnaire. The secondary objective was to examine whether the use of NbN as a teaching tool affects "hard" knowledge. We hypothesized that medical students introduced to the NbN approach would have a more favorable outlook on the scientific foundation of psychiatry in particular and towards the discipline of psychiatry in general.

Methods

Design – a prospective, single-blind questionnaire-based cohort study that included an intervention and control group. The intervention group was introduced to the NbN method and app during their psychopharmacology classes, while the control group was taught using the traditional nomenclature. Both groups received pre and post questionnaires at the beginning and end of the clerkship, measuring changes in students' views regarding psychopharmacological treatment, perception of patient stigma, perception of the psychiatric practice in general, and general knowledge in psychopharmacology (see appendix, and see complete questions in Tables 3 and 4).

Study population – A sample of 56 Medical students from the Hebrew University of Jerusalem, Israel, was divided into an intervenstion group (36 students) and a control group (20 students) during their clerkship in psychiatry in two separate campuses (Eitanim Mental Health Center and Kfar Shaul Mental Health Center, both in Jerusalem). The two campuses served as intervention groups and controls, respectively, while students' allocation to each campus was unrelated to any former background. Clerkship in psychiatry requires a four-hour class in psychopharmacology. The study's introduction included general phrases like *"we would like to ask you a few questions regarding psychopharmacology and psychiatry."* For the intervention group, psychopharmacology classes included the basic introduction to neurotranmitters, modes of action and brain circuitry relevant to psychopathology and the pharmacotherapy. The intervention itself took place at the final part of the class (about 25 minutes) and was dedicated to introduce NbN briefly (explaining the rational of pharmacologically-driven nomenclature), and a short demonstration for how to use the app. The control group was taught psychopharmacology using the traditional terminology, and was not aware of NbN during the clerkship. No other

interventions were made for both of the groups. The overall time spent tutoring psychopharmacology in the two campuses was equal (4 hours).

Data collection - Data were collected using pre and post questionnaires. Every student (in each group) filled up an 11-question form in the 2nd week of clerkship and again during the last week. Pre and post questionnaires were identical, except for an added question referring to the NbN app in the intervention group's post questionnaire. Questionnaires (Appendix A) included three sections: "effects of terminology on patient views," "knowledge on psychiatric pharmacology," "general views on psychiatric medication," and a question about general interest in residency in psychiatry. Most of the questions were designed to be answered on a numeric scale of 1 to 10 (1- do not agree, 10- highly agree), few (items 2.3, 2.4) used the 1-10 scale as an absolute value. One item (no. 2.5 "The number of different pharmacological tools in psychiatry is:") was on a scale of 5 to "more than 50". This item's scores results appeared to show trends similar to other items in the same section, hence did not add information. Since the numeric scale in this item was different from all other items, its results are not presented for convenience considerations.

Statistical analyses – the data were analyzed using within-group and between-group comparisons. A "pre vs. post" comparison was made for each item in the questionnaire, separately in every study group. Comparisons were made between the average score of each item (pre vs. post) using a paired t-test. Additionally, "pre vs. pre" comparison was held for the two groups (NbN intervention vs. control) in order to validate a non-significant similar baseline and "post vs. post" comparisons were held for each item, using a two-sample test,in order to check if post scores are significantly different between the groups. Finally, a "Delta comparison test" was held; a delta (Δ) score was calculated for each group (post score minus pre score) for each item.

Average deltas were compared between the groups (using a two-sample test) to examine whether the average deltas are significantly different.

Ethical issues and registration – the study was approved by the Jerusalem Mental Health Center IRB committee and was submitted as a study in ClinicalTrials.gov. (no. NCT04375254)

3. **Results**

demographic details (% females equal, average age p=0.45) did not differ significantly between the groups.

Delta comparisons (figure 1, see appendix d for full data) – six out of ten items showed a significant difference ($p<0.01$) between delta mean scores of the two groups. All mean deltas in the intervention group showed a "positive direction," except for item 3.1 ("using a terminology that is disease-based helps to plan the next pharmacological step"), which showed a negative delta, similar to that of the control group. The Control group showed negative or 0 deltas in nine out of ten items.

(figure 1 – delta score comparisons, see figure document)

Figure 1 – Delta score comparisons. The bar graph shows average delta scores (post- minus pre- scorings) for the control and intervention groups. The horizontal axis shows the questionnaire item numbers (e.g., 0, 1.1, 1.2), except for item 2.5 ("The number of different pharmacological tools in psychiatry is:"), which was left out due to different scoring units (control mean delta -4.8, intervention 8.1, p=0.003). Star sign= significant difference ($p<0.01$). The intervention group showed positive deltas (i.e., significant post higher scorings) in all items except item 3.1 ("using a terminology that is disease-based helps to plan the next pharmacological step"), pointing to less confidence with the current nomenclature. The Control group showed negative or smaller deltas, including item 0 ("considering doing my residency in psychiatry").

Within-group comparisons (table 3, see appendix c for full data) – overviewing pre vs. post comparisons, nine out of ten items showed significantly higher scores in the intervention group ($p<0.01$). In contrast, only two items in the control group showed significantly higher mean scores in the post questionnaire. It is particularly interesting to note that scores of the item: "I'm considering doing my residency in psychiatry" were significantly higher in the post-intervention

questionnaires (mean 3.9 pre, Sd=3.1, vs. post 5.2 Sd=2.9, p<0.01), compared to no significant change in the control group (mean 4.4 pre, Sd=2.5, vs. 4.3 Sd=2.5, p=0.73)

(table 3- see figure document)

Table 3 – within-group comparisons – paired t-tests were held to compare pre vs. post mean scores for each item in the questionnaire. Mean post scores in the intervention group were significantly higher in nine out of ten items, while only three items in the control group showed significant change. Note that item 1.2 ("prescribing antidepressants to non-depressed anxiety patients is confusing and may affect the confidence in the treatment") showed a significant "negative" difference, pointing to a lack of agreement with this saying. The mean score for the saying "I find the NbN app. useful" was 8.4 on a scale of 1-10.

Between-group comparison (table 4) average scores across the two groups (control vs. intervention) in the pre questionnaires did not show significant differences (p<0.05) regarding their views about choosing residency in psychiatry, the effect of terminology on patient views, and general view on psychiatric medication. Regarding knowledge of psychiatric pharmacology, only one item ("I feel I understand the underlying mechanisms behind psychiatric medication") showed a significant difference (mean score of 4.3 in controls vs. 2.9 in the intervention group, p<0.01). In the post vs. post comparisons, five out of ten items showed significantly higher intervention scores (p<0.05); two items measuring the effect of terminology on patient views ("The use of medications labeled 'antipsychotic' is stigmatizing for the patient",a mean score of 7.8 vs. 5.2 p<0.01, and "Prescribing antidepressants to non-depressed anxiety patients is confusing and may affect the confidence in the treatment",mean score of 6.7 vs. 3.7 p<0.01), two "hard knowledge" questions in the section about knowledge of psychiatric pharmacology ("The number of neurotransmitters that are affected by psychiatric medications is:" and "The number of mechanisms of psychiatric medication is:") showed a similar trend, along with the 5th item ("Using a terminology that is pharmacology-based helps to plan the next pharmacological step" with a mean 7.3 vs. 5.9 p<0.05) in the "general view about psychiatric medication" section.

(table 4 – between-group comparisons, see figure document)

Table 4 – between-group comparisons show no significant differences between the control and intervention groups in the preliminary pre questionnaire, except items 2.2. In post scores, the intervention group questionnaire shows significantly higher mean scores in five items.

4. **Discussion**

Using NbN as a teaching tool for this pilot study yielded significant, positive differences in views on psychopharmacology and on the psychiatric profession and in students' perspective on "considering doing my residency in psychiatry". Additionally, significant improvement was found regarding "hard" knowledge of the intervention group as compared to the controls (who were taught using the traditional, indication-based nomenclature).

Several limitations are acknowledged.First, possible shortcomings or biases created by over-investment in the intervention group's study curriculum. To minimize these possible biases, students in the control group were taught by senior lecturers, with high scores in past faculty evaluation surveys. Second, items 3.1 and 3.2 ("using a terminology that is disease-based helps to plan the next pharmacological step," "using a terminology that is pharmacology-based helps to plan the next pharmacological step ") might have been affected by a question-order bias or an acquiescence bias. To address these possible biases, students were informed of complete anonymity and were instructed that no "right answer" was expected. Indeed, based on the delta scores, both groups showed a similar approach to indication-based nomenclature regardless of being introduced to NbN.

A clear limitation is the relatively small sample size that impairs the power of the above results. Although a bigger sample is undoubtedly needed, the findings are nonetheless consistent with

former surveys conducted onmuch larger sample sizes, which summarized that "the clinicians found the available indication-based nomenclature system dissatisfactory, non-intuitive, confusing,and doubt-inducing for them and the patients." (Zohar et al, 2014) Moreover, the positive effect demonstrated for NbN as a teaching tool was well anticipated in editorials, reviews, and statements, including an APA position statement published in June 2019, stating that "NbN is providing an important teaching tool that presents the depth and richness of the neuroscience fabric of psychotropics."

Finally, another shortcoming is the absolute values of mean scores. While all significant changes demonstrated above are statistically valid (both when using t-test and a-parametric tests), the mean differences are often small in absolute values. It is also worthy to note that when analyzing the data in repeated measures ANOVA, the intervention group does not appear as a key factor. This requires further testing and much larger samples. However,the general trend is well presented and is a preface for further testing. Further studies with a larger sample size are warranted as well as studies that will explore the effects of NbN as a teaching tool on residents in psychiatry.

Conclusions

The impressive developments in neuroscience have not been well represented in the current nomenclature of psychotropics. The disease-based naming classification, which is commonly practiced, is confusing to both patients and caregivers. It also does not make justice to the wealth of neuroscience which has been accumulated over the past sixty years. The NbN concept is pharmacology driven, based on current scientific knowledge, and might be a step towards a better updated nomenclature. To support this claim, a pilot study is presented, aiming to examine the effect of NbN as a teaching tool for medical students. We used pre vs. post questionnaires in

a sample divided into a control group (taught psychopharmacology using traditional terminology) and and intervention group (taught phsychopharmacology using the NbN approach and tools). A positive effect was observed for the intervention group.Significant differences emerged between the two groups in favor of the intervention group, including positive views towards psychopharmacology, the scientific basis of psychiatry, and preference for choosing residency in psychiatry. Other populations, including general practitioners, psychiatrists, and patients, are warranted for further studies with larger sample size.

5. Author disclosure:

Funding source: The study had recieved no funding.

Contributors: The entire reseach was designed and built by the three authors jointly. Dr. Zemach and Dr. Minkin-Levy both conducted the actual teaching of the intervention groups. Literature was arranged and integrated to the study by Drs. Zemach and Minkin-Levy. Statistics were done by Dr. Zemach, and discussed with the participation of all three authors. The actual writing was done by all participants.

Conflict of interest: there are no conflict of interest issues to declare.

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Table 1 – First Dimension of The NbN System

Ten Pharmacological Domains	
1	Acetylcholine
2	Dopamine
3	GABA
4	Glutamate
5	Histamine
6	Orexin
7	Melatonin
8	Norepinephrine
9	Opioid
10	Serotonin

Table 2 – Second Dimension of The NbN System

Nine Modes of Action	
1	Receptor agonist
2	Receptor partial agonist
3	Receptor antagonist
4	Reuptake inhibitor
5	Releaser
6	Enzyme inhibitor
7	Ion channel blocker
8	Positive allosteric modulator (PAM)
9	Enzyme modulator

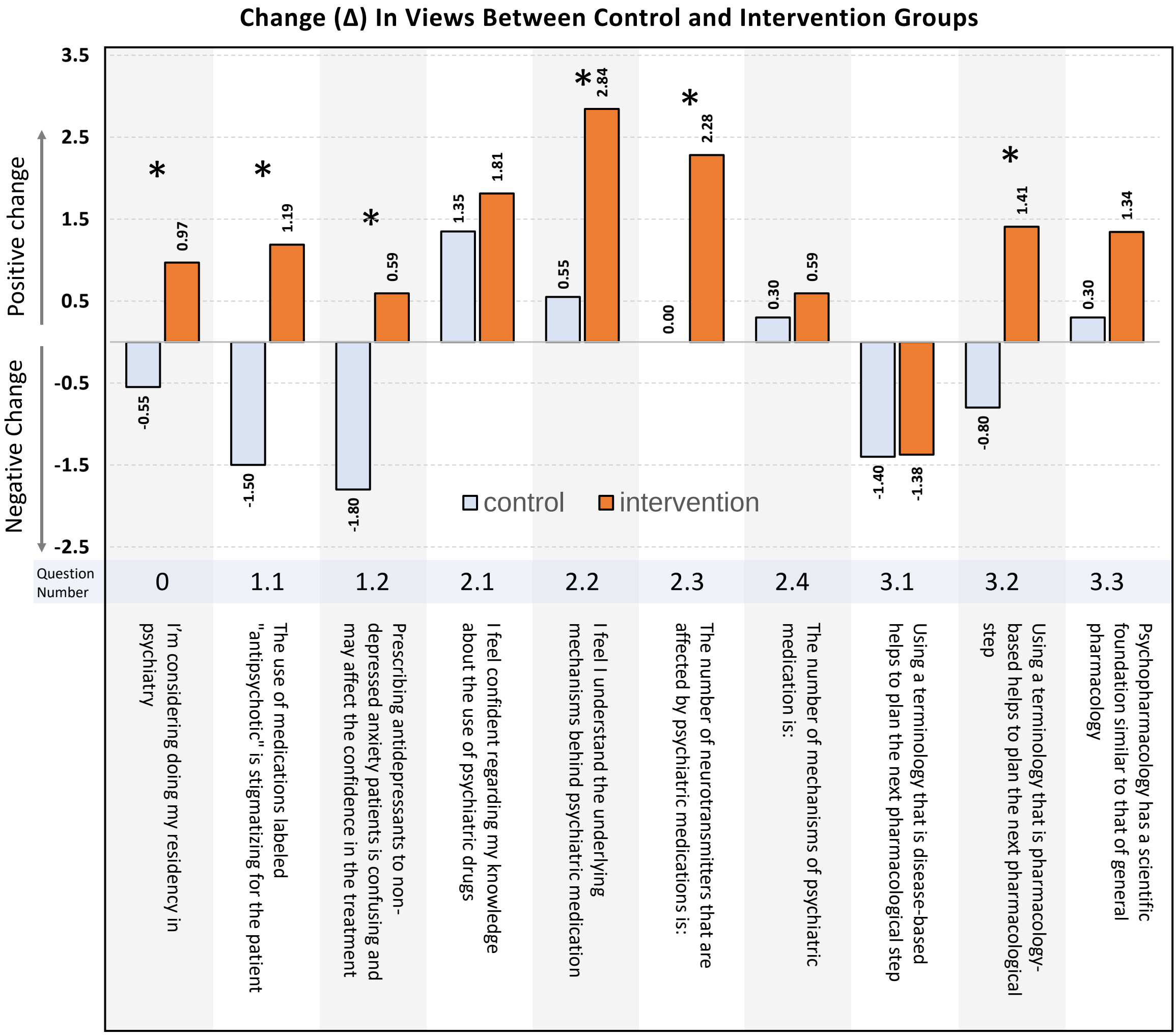
Table 3 – Within Group Comparisons

		Control group					Intervention group				
		Pre		Post			Pre		Post		
Section	**Item***	**Mean**	**Sd**	**Mean**	**Sd**	**p**	**Mean**	**Sd**	**Mean**	**Sd**	**p**
Interest in residency	**0**	4.4	2.5	4.3	2.5	0.734	3.9	3.1	5.2	2.9	***0.000***
Effect of terminology on patient views	**1.1**	6.2	2.9	5.2	2.1	0.115	6.6	2.0	7.8	1.8	***0.013***
	1.2	5.1	2.2	3.7	2.5	***0.023***	6.0	2.0	6.7	2.5	0.219
Knowledge of psychopharmacology	**2.1**	2.8	2.5	4.6	1.3	***0.002***	2.6	1.8	4.4	2.0	***0.000***
	2.2	4.3	4.5	5.3	1.8	0.101	2.9	1.6	5.6	1.8	***0.000***
	2.3	5.4	5.0	5.9	1.3	0.111	4.7	1.7	7.0	1.9	***0.000***
	2.4	4.5	4.0	5.3	1.2	***0.022***	5.3	2.1	6.3	1.8	***0.019***
General view on Psychiatric medication	**3.1**	6.0	6.5	5.1	2.7	0.271	5.7	2.2	4.2	2.3	***0.001***
	3.2	6.1	6.0	5.9	2.0	0.531	5.8	2.3	7.3	1.9	***0.002***
	3.3	4.1	4.0	4.8	2.5	0.213	4.3	2.5	5.6	2.2	***0.001***
Finds NbN app Useful									8.4		
***Questionnaire Items**											
Interest in residency	**0**	I'm considering doing my residency in psychiatry									
Effect of terminology on patient views	**1.1**	The use of medications labelled "antipsychotic" is stigmatizing for the patient									
	1.2	Prescribing antidepressants to non-depressed anxiety patients is confusing and may affect the confidence in the treatment									
Knowledge of psychopharmacology	**2.1**	I feel confident regarding my knowledge about the use of psychiatric drugs									
	2.2	I feel I understand the underlying mechanisms behind psychiatric medication									
	2.3	The number of neurotransmitters that are affected by psychiatric medications is:									
	2.4	The number of mechanisms (modes of action, e.g. reuptake inhibition, receptor antagonist) of psychiatric medication is:									
General view on Psychiatric medication	**3.1**	Using a terminology that is disease-based (antidepressants, antipsychotics etc.) helps to plan the next pharmacological step									
	3.2	Using a terminology that is pharmacology-based (dopaminergic/ serotonergic etc) helps to plan the next pharmacological step									
	3.3	Psychopharmacology has a strong scientific foundation, similar to that of general pharmacology.									

Table 4 – Between Group Comparisons

		Pre			Post		
		Control	Intervention		Control	Intervention	
Section	**Item***	**Mean**	**Mean**	**p**	**Mean**	**Mean**	**p**
Interest in residency	**0**	4.4	3.9	0.53	4.3	5.2	0.25
Effect of terminology on patient views	**1.1**	6.2	6.6	0.48	5.2	7.8	**0.00**
	1.2	5.1	6.0	0.13	3.7	6.7	**0.00**
Knowledge of psychopharmacology	**2.1**	2.8	2.6	0.65	4.6	4.4	0.70
	2.2	4.3	2.9	**0.00**	5.3	5.6	0.62
	2.3	5.4	4.7	0.14	5.9	7.0	**0.03**
	2.4	4.5	5.3	0.09	5.3	6.3	**0.05**
General view on Psychiatric medication	**3.1**	6.0	5.7	0.56	5.1	4.2	0.21
	3.2	6.1	5.8	0.56	5.9	7.3	**0.02**
	3.3	4.1	4.3	0.74	4.8	5.6	0.28

***Questionnaire Items**		
Interest in residency	**0**	I'm considering doing my residency in psychiatry
Effect of terminology on patient views	**1.1**	The use of medications labelled "antipsychotic" is stigmatizing for the patient
	1.2	Prescribing antidepressants to non-depressed anxiety patients is confusing and may affect the confidence in the treatment
Knowledge of psychopharmacology	**2.1**	I feel confident regarding my knowledge about the use of psychiatric drugs
	2.2	I feel I understand the underlying mechanisms behind psychiatric medication
	2.3	The number of neurotransmitters that are affected by psychiatric medications is:
	2.4	The number of mechanisms (modes of action, e.g. reuptake inhibition, receptor antagonist) of psychiatric medication is:
General view on Psychiatric medication	**3.1**	Using a terminology that is disease-based (antidepressants, antipsychotics etc.) helps to plan the next pharmacological step
	3.2	Using a terminology that is pharmacology-based (dopaminergic/ serotonergic etc) helps to plan the next pharmacological step
	3.3	Psychopharmacology has a strong scientific foundation, similar to that of general pharmacology.



Raw data