

# SMARTPHONE APPLICATION TO REPORT AWAKE BRUXISM: NORWEGIAN TRANSLATION AND CULTURAL ADAPTATION

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## ABSTRACT

**INTRODUCTION:** A smartphone application based on ecological momentary assessment reminding the patient to report awake bruxism (AB) behavior in real-time and store this information has been developed in a cooperation with more than 50 universities.

**OBJECTIVES:** This paper aims to present the process of translating the application into Norwegian and consequently, presents the principles of the application.

**MATERIAL AND METHODS:** A collection of strings, sequences of alphanumeric texts important for functioning of the application as well as introductory guide were translated individually by two Norwegian dental students, using internet platform for translation (POEditor). The final translation was reviewed for approval and back-translated to English by a Norwegian dentist specializing in temporomandibular disorders and orofacial pain. The back-translation was compared with the original text by a member of the BruxApp team. Finally, the application was tested by an individual third party, a group of Norwegian dental students, emphasizing the language, cultural concurrence and the experience of the application.

**RESULTS:** After testing the application, some alterations based on a feedback were made to the translation to improve the language to be more natural and adapted to a Norwegian user. Several parts of the text itself were considered unnecessary or too advanced, therefore were simplified.

**CONCLUSIONS:** The official Norwegian translation and cultural adaptation of the application was accepted by the international BruxApp consortium, which defines diagnostic standards and treatment in the field of awake bruxism. The application constitutes a valuable tool for diagnosis of AB in Norway.

**KEY WORDS:** bruxism, ecological momentary assessment, awake bruxism, translation, BruxApp.

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## INTRODUCTION

Based on the state of a patient, the classification of bruxism can be divided into two categories, such as

awake bruxism (AB) and sleep bruxism (SB) [1]. Most of the available studies on bruxism is focused on SB, and there is still a lot to learn about the epidemiology of AB [2]. The current standard in diagnosing AB [3]

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is electromyography (EMG) or ecological momentary assessment (EMA), in which the patient reports about its condition on various occasions during the day. Due to the nature of examination, EMG registrations may eventually lead to difficulties. Therefore, EMA could be considered a more suitable alternative in diagnosis of AB. Data collected from patients' reports could contribute to an increased epidemiological comprehension and knowledge about musculoskeletal pain as well as the connection between different types of bruxism. This form of data collection facilitates the observation of bruxism symptoms (e.g., bracing, tooth grinding, clenching), and shows a potential for further investigation of AB. A search in databases of PubMed and the "Norwegian Dental Journal" show limited number of publications on the prevalence of AB or SB in the Norwegian population. Therefore, the collection and comparison of data could be simplified by the implementation of a standardized EMA approach. A smartphone application (BruxApp) [4] reminding the patient to report AB behavior in real-time and store this information has been developed in a cooperation with more than 50 universities. In this application, EMA is being used as the primary method to collect the data [5, 6], and it has been translated into many languages, also to Norwegian.

## OBJECTIVES

The aim of this paper was to present the process of translating the application to Norwegian and principles of the application.

## MATERIAL AND METHODS

The goal of the application is to provide a platform for collection of data on AB using EMA, a method of reporting symptoms and behavior in real-time [7], using a journal, smartphone application, etc. This eliminates the need for frequent calls to a clinician to report the data. The user gets a remainder at different times during the day and requested to provide the current state of jaw. Five alternatives are provided, including relaxed, mandible bracing (no teeth contact), teeth contact, teeth clenching, and teeth grinding. The data is stored in the application and available for export if necessary. The notifications must be acknowledged within 10 minutes for the registration to be valid, because it is the state of the patient at the precise time of notification that is needed. The user can choose the amount of notifications per day, and can set up intervals without notifications, if there are times where interaction with a smartphone is difficult. Therefore, the application may function as a type of biofeedback therapy, which is defined to monitor processes that are usually not under conscious control [8].

## TRANSLATION INTO NORWEGIAN AND CULTURAL ADAPTATION

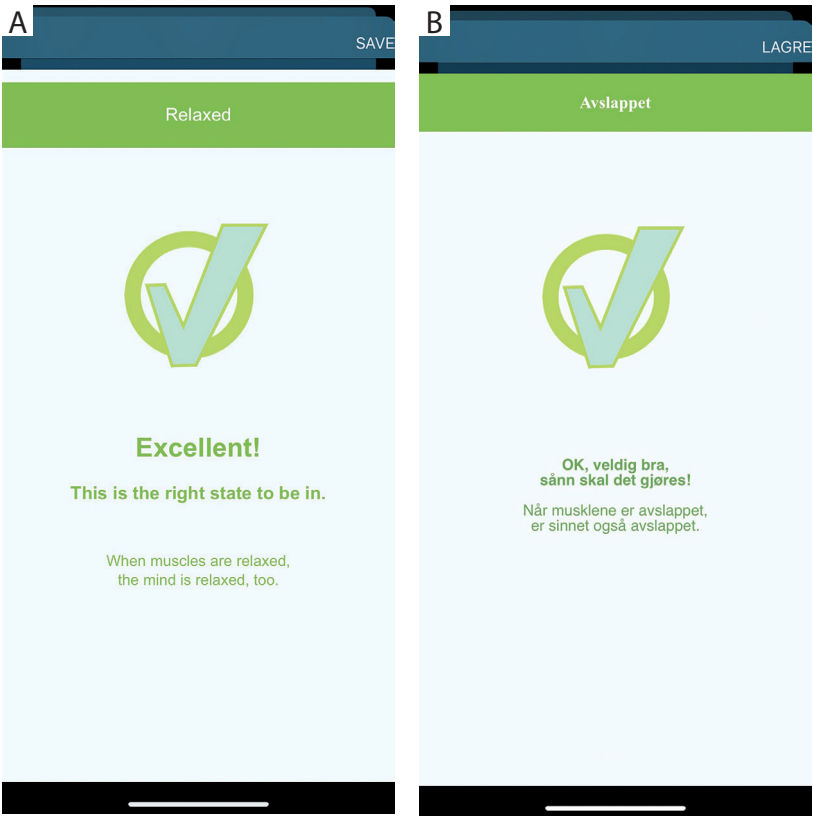
The English version of the application was used as a template for its translation into other languages. Cultural adaptation is defined as "the systematic modification of an evidence-based treatment or intervention protocol to consider language, culture, and context in such a way that it is compatible with the client's cultural patterns meanings, and values" [7], which was considered during all steps of the translation process. Firstly, two Norwegian dental students at the Jagiellonian University in Kraków were instructed by an expert in bruxism and a member of the BruxApp team. Subsequently, the application was tested by the students before the translation process begun. The translation was performed in two parts. A collection of strings, sequences of alphanumeric texts important for the functioning of the application were translated using an internet platform for translation (POEditor) [9], where all strings are uploaded in the source language, and contributors translate each string in their individual language. For each string, there is also a comment section for efficient communication between the translators and the project leader, wherever specifications are needed. Translations can be marked as unclear in case of any doubts, so the translator can return to the string at another time. This allows for a highly organized and quick way to translate large numbers of strings to different languages. The introductory guide of the application was translated individually by the two students from an English template, and a mutual translation was created from comparing the two translations. The final translation was reviewed for approval and back-translated to English by a Norwegian dentist specializing in TMD and orofacial pain. Back-translation is a method of assessing the quality of a translation by translating it back to the source language. The purpose is to find any discrepancies between the original text and back-translated text. This method was introduced by cross-cultural psychologist Richard W. Brislin in 1970 [10] and has been included in several translation guidelines ever since [11]. The back-translation was compared to the original text by a member of the BruxApp team. Finally, the application was tested by an individual third party, a group of Norwegian dental students, with emphasis on the language, cultural concurrence, and the overall experience.

## RESULTS

After testing the application, a few alterations based on a feedback were made to the translation to improve the language to be more natural and adapted to a Norwegian user. Some of the English text and its Norwegian translations are shown through screen-



**FIGURE 1.** Reporting of current condition in BruxApp. English text (left) and Norwegian translation (right)



**FIGURE 2.** Feedback from BruxApp after reporting of relaxed jaw muscles. English text (left) and Norwegian translation (right)

**TABLE 1.** Examples of simplified English text in the process of translation to Norwegian

English text	Norwegian translation
This setting states the number of the alerts, which you will receive during the day; keep in mind that, the higher the frequency is, the higher the precision of the diagnosis and the effectiveness in reprogramming the central nervous system will be.	Denne innstillingen angir antall varsler du vil få i løpet av dagen. Husk at jo flere varsler du får, desto mer presis blir diagnosen og desto bedre blir virkningen av opptreningen.
This function is essential if you want to have the cognitive behavioral re-education to the jaw rest position. Only the alert (with the chosen frequency) will appear without the data recording.	Denne funksjonen velger du hvis du ønsker å trene opp kjevens naturlige hvileposisjon på nytt. Du vil kun få varselet (med valgt hyppighet) uten dataregistreringen.

shots from the application in Figures 1 and 2. Several parts of the text itself were considered unnecessary or too advanced, therefore were simplified. Examples are specified in Table 1. As the back-translation was found to have minimal discrepancy with the original text and the Norwegian version of application was thoroughly verified, the validity of translation was confirmed, and the application was ready to be introduced in Norway.

## DISCUSSION

Back-translation has been included in several recommendations for cross-cultural adaptation processes [12, 13]. Although its true efficacy in validating the quality of translation has been questioned [14], it does provide an extra verification step in the translation process, and it is therefore assumed to benefit the final outcome rather than deteriorate it. Since the cultural adaptation may create some minor discrepancies, the back-translation was not expected to be completely without a difference from the original.

A modern lifestyle is often hectic and associated with stress. Constant levels of stress may contribute to maintain the muscles in a tense position and other signs of bruxism, which may cause pain in temporomandibular joints or headaches [15]. As previously mentioned, AB has been not widely investigated, and there are not many publications available on awake bruxism. For this reason, it is important to establish research protocols for further investigations. According to a survey commissioned by Statistics Norway, 92% of the Norwegian population had access to a smartphone in 2018 [16]. In the third quarter of 2019, there were 5,356,789 of inhabitants in Norway [17], which means that there are at least 4,928,245 of potential users who can contribute to the epidemiologic data on AB in Norway.

To estimate the efficiency of EMA in the management and diagnostics of AB, it is necessary to establish clinical research protocols. The results depend on the adherence of patients and their willingness to complete the instructions from the application. Nevertheless, the results may be valuable on both individual and population level. On the individual level, the ap-

plication serves both as a tool for assessing bruxism in patients and as an education platform to understand possible consequences. With the use of notifications at random intervals, it also serves as a biofeedback mechanism, reminding the users to be aware of the state of their jaws and if in a tense state, instruct them to relax the muscles, which could be a sufficient first-line treatment itself, but might also improve the effects of other treatment regimens. The notifications not only remind the patients to be aware of their state at a particular moment but could also lead to an overall improved awareness and help the patients to unlearn the bruxism-related habits. At population level, data collection from the application can be used by researchers to investigate prevalence, effects, and other factors associated with AB.

As the application records bruxism information about a patient, the issue of privacy and data protection should be mentioned. The application does not store any personal information about the user, and the data on bruxism is recorded through user's interaction. The privacy of the user is therefore not compromised. If the data that is recorded in the application is exported for further research, all issues related to GDPR regulations and data protection must be taken into consideration.

The translation and cultural adaptation of the application allow its accessibility to a greater number of users, improving the international communication between dental professionals about AB. By implementing EMA as a standard method, for example with the use of an application for smartphones, the subject of awake bruxism could be further investigated. Such a standardization simplifies the collection of data for individual doctors regarding diagnostics and treatments, but also for research purposes.

## CONCLUSIONS

The official Norwegian translation and cultural adaptation of the application was accepted by the international BruxApp consortium, which defines diagnostic standards and treatments in the field of awake bruxism. The application constitutes a valuable tool for diagnosis of awake bruxism in Norway.

## CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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