Characterization of Elderly and Non-Elderly Patients with Bronchial Asthma:
A Clinical Perspective of the Inhaler Technique

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Resumo

Introdução: A terapêutica da asma requer, além de medicação apropriada, uma correta técnica inalatória. No entanto, o uso incorreto de inaladores é frequente. O médico desempenha um papel essencial na aquisição do efeito terapêutico, tanto pela aprendizagem inicial de uma técnica correta, como pela sua manutenção. Este estudo pretende comparar o tipo e a frequência de erros na técnica inalatória em asmáticos idosos e não-idosos; comparar a auto-perceção do domínio da técnica inalatória com a capacidade real de execução e avaliar fatores influenciadores da técnica.

Métodos: Estudo observacional transversal de 92 idosos e 100 não-idosos asmáticos seguidos no Centro Hospitalar Cova da Beira. Um questionário estandardizado foi aplicado e foi solicitada a demonstração da técnica inalatória. No total, 130 demonstrações nos não-idosos e 118 demonstrações nos idosos foram feitas. Os erros foram avaliados usando *checklists* baseadas nas instruções dos fabricantes e a técnica inalatória foi classificada como correta, aceitável ou incorreta de acordo com critérios previamente publicados. Os dados foram analisados recorrendo-se aos testes do qui-quadrado ou exato de Fisher, usando o *Software Package for Social Sciences (SPSS®)*, versão 23.0, considerando um valor-*p* menor ou igual a 0,05 como significativo.

Resultados: A técnica foi correta em 13,6%, aceitável em 61,0% e incorreta em 25,4% dos idosos asmáticos, comparativamente com 15,4%, 55,4% e 29,2% nos não-idosos, respetivamente. O inalador pressurizado / *Metered dose inhaler* (MDI) demonstrou o pior desempenho com apenas 7,7% dos idosos e 19,6% dos não-idosos a não demonstrarem erros. Contrariamente, o *Diskus®* demonstrou o melhor desempenho em ambos os grupos. Nenhuma diferença entre os dois grupos foi encontrada em relação à técnica inalatória. O passo mais errado foi não inclinar a cabeça para trás ao inalar, um erro *minor*. Apenas 11,1% dos idosos que classificaram o seu inalador como fácil e 12,7% dos que afirmavam ter técnica certa não tinham erros. Apesar de quase todos os doentes receberem treino inicial, apenas 49,2% dos idosos e 55,4% dos não-idosos tinham treino frequente. A avaliação reiterada da técnica estava associada a melhor técnica nos não-idosos mas não nos idosos. Nenhuma associação foi encontrada entre técnica e sexo, habilitações, classe social ou número de inaladores.

Discussão: Uma técnica incorreta permanece comum. O MDI apresentou maior proporção de erros quando comparado com os *Dry Powder Inhalers*, sugerindo-o como menos *user friendly*. No entanto, todos os dispositivo apresentaram muitos erros, consistente com *guidelines* que afirmam os inaladores equivalentes se usados corretamente. Os doentes tendem a sobrestimar o uso correto, pelo que, é insuficiente perguntar sobre a sua perceção. Antes, a avaliação frequente da técnica é necessária pois esquecem-se das instruções com o tempo.

Palavras-chave

Asma, idosos, não-idosos, inaladores, técnica inalatória.

Resumo Alargado

Introdução: A asma, embora não tenha cura, pode ser eficazmente tratada e controlada. Para tal, além de medicação apropriada, é essencial uma correta técnica inalatória. No entanto, uma proporção assinalável dos doentes manipula erradamente os seus inaladores. Este problema assume maior proporção na população idosa, por diversos motivos, para além da própria biologia do envelhecimento. Isso conduz a situações de tratamento subóptimo, obrigando ao aumento da dose ou à prescrição de terapêuticas adicionais em doentes que poderiam ser tratados adequadamente com a sua medicação habitual. Este estudo pretende comparar o tipo e a frequência de erros na técnica inalatória em asmáticos idosos e não-idosos; comparar a auto-perceção do domínio da técnica inalatória com a capacidade real de execução em asmáticos idosos e não-idosos e avaliar fatores influenciadores da técnica inalatória.

Métodos: Estudo observacional transversal de 92 idosos e 100 não-idosos asmáticos seguidos nas consultas externas de Imuno-alergologia e de Pneumologia do Centro Hospitalar Cova da Beira de março de 2015 a março de 2016. Foi utilizado um questionário estandardizado para recolher informação sociodemográfica e clínica. Para o rastreio de depressão, utilizou-se a escala de depressão geriátrica na população idosa e a escala *Centre for Epidemiological Studies Depression Scale* na população não-idosa e, para o rastreio de disfunção cognitiva, foi utilizado o *Mini-Mental State Examination questionnaire*. A avaliação da técnica inalatória foi feita recorrendo-se a um questionário estandardizado. Era solicitada a avaliação da auto-perceção no uso correto e na dificuldade de manipulação do inalador, assim como se teve treino aquando da prescrição do inalador, se a técnica é verificada frequentemente e como é realizada essa verificação. Numa segunda etapa, era solicitada a demonstração da técnica inalatória, usando *checklists* baseadas nas instruções dos fabricantes para assinalar os erros cometidos. A técnica era classificada como correta, aceitável ou incorreta de acordo com critérios previamente publicados. No total, 130 demonstrações da manipulação de inaladores foram observadas nos não-idosos e 118 demonstrações nos idosos. Os dados foram analisados recorrendo-se aos testes do qui-quadrado ou exato de Fisher, usando o *Software Package for Social Sciences*®, versão 23.0, considerando um valor-p menor ou igual a 0,05 como estatisticamente significativo.

Resultados: A técnica inalatória foi correta em 13,6%, aceitável com erros *minor* em 61,0% e incorreta com erros *major* em 25,4% dos idosos, comparativamente a 15,4%, 55,4% e 29,2% nos não-idosos, respetivamente. O inalador pressurizado / *Metered dose inhaler* (MDI) foi o inalador com pior desempenho em ambos os grupos com apenas 7,7% dos idosos e 19,6% dos não-idosos a demonstrarem uma manipulação correta. O inalador de pó seco do tipo *Diskus*® (DK) foi o dispositivo com melhor desempenho em ambos os grupos. Não foi encontrada

nenhuma diferença entre os dois grupos na manipulação de qualquer inalador. Os três inaladores mais frequentes foram o MDI, o *Turbohaler®* e DK. O passo mais frequentemente errado foi não inclinar a cabeça para trás ao inalar, um erro *minor*. A percentagem de erro para cada passo foi similar entre ambos os grupos com exceção de "falha ao colocar o MDI adequadamente na boca" e "não expirar lentamente após inalação com o DK", apresentando maior proporção de erro nos idosos comparativamente aos não-idosos. Verificou-se que, em ambos os grupos, existe uma sobrevalorização da capacidade de técnica inalatória, com 84,7% dos idosos e 84,6% dos não-idosos a classificam o seu inalador como fácil. No entanto, apenas 13,0% dos idosos e 18,2% dos não-idosos demonstraram uma técnica totalmente correta. Quase todos os doentes receberam treino inicial do seu inalador. No entanto, nenhuma associação significativa entre receber treino inicial e melhor técnica foi encontrada. Apenas 49,2% dos idosos e 55,4% dos não-idosos tinham treino frequente do seu inalador. Receber treino frequente estava associado significativamente a melhor técnica inalatória nos não-idosos mas não nos idosos. Nenhuma associação significativa foi encontrada entre técnica inalatória e sexo, habilitações, classe social ou número de inaladores usados em algum dos grupos estudados.

Discussão: Uma técnica inalatória incorreta permanece comum, embora nenhuma diferença tenha sido encontrada entre idosos e não-idosos. Isto é motivo de preocupação pois origina um tratamento subóptimo e falta de controlo da doença. Neste estudo, o MDI foi o inalador com maior proporção de erros e menor técnica inalatória correta, comparativamente com inaladores de pó seco (Dry powder inhalers; DPI), sugerindo-o como menos *user friendly*. Pelo contrário, o DK foi o inalador com melhor desempenho em ambos os grupos. No entanto, nenhum inalador mostrou ser superior em relação a outro tendo em conta os passos individuais, consistente com *guidelines* que afirmam os inaladores como equivalentes desde que usados corretamente. Embora a técnica inalatória seja inicialmente ensinada a quase todos os doentes, os erros permanecem comuns se o treino frequente não for assegurado pois, os doentes, tendem a esquecer-se das instruções com o tempo. Não é suficiente perguntar aos asmáticos sobre a sua perceção na dificuldade e na técnica inalatória pois eles tendem a sobrestimar o uso correto. Assim, os médicos devem ensinar uma técnica correta e avaliar frequentemente a manipulação dos inaladores, com correção da técnica errada e demonstração da técnica certa. Deste modo, têm um papel fundamental em alcançar um efeito terapêutico ótimo, tanto pelo ensino de uma técnica inicial correta como pela sua manutenção ao longo do tempo.

Abstract

Introduction: Asthma therapy requires, together with appropriate medication, a correct inhalational technique. However, incorrect inhaler usage is frequent. Thus, the physician has a major role in accomplishing a therapeutic effect, both in terms of achieving an initial correct technique but also in maintaining correct use. This study aims to compare inhaler technique error frequency and type between elderly and non-elderly asthmatics; to compare inhaler technique self-perception with real performance and to evaluate inhaler technique determinants.

Methods: Cross-sectional assessment of 92 elderly and 100 non-elderly asthmatic patients followed up at Centro Hospitalar Cova da Beira, Portugal. A standardized questionnaire was applied and inhaler technique demonstration was requested, with a total 130 non-elderly and 118 elderly inhaler demonstrations. Errors were accessed using checklists based on manufacturers' instructions and Inhaler technique was graded as correct, acceptable or incorrect based upon previously published criteria. Data was analysed using Chi-Square Test or Fischer's Exact Test, using the Software Package for Social Sciences®, version 23.0, regarding a p-value less than or equal to 0.05 as significant.

Results: Technique was correct in 13.6%, acceptable in 61.0% and incorrect in 25.4% of the elderly asthmatics, compared to 15.4%, 55.4% and 29.2% of the non-elderly asthmatics, respectively. Metered dose inhaler (MDI) showed the worst performance with only 7.7% of the elderly and 19.6% of the non-elderly showing no errors. In contrast, Diskus® showed the best performance in both groups. No difference between study groups was found for inhaler technique. The most common mistake was failure to tilt the head back when inhaling, a minor error. Only 11.1% of the elderly who classified their inhaler as easy and 12.7% who stated their technique as correct had no errors. Although almost all patients had initial training, only 49.2% of the elderly and 55.4% of the non-elderly had frequent training. Frequent assessment was associated with a better technique in the non-elderly but not in the elderly. No association was found between technique and gender, education, social class or inhaler number.

Discussion: Incorrect inhaler technique remains common. MDI was found to have a higher proportion of errors when compared to Dry Powder Inhalers, suggesting it as less user friendly. However, all devices showed a large proportion of errors, consistent with guidelines stating devices as equivalent if handled correctly. Patients tend to overestimate their technique as correct. Thus, it is not sufficient to ask about their perception in device handling. Rather, frequent assessment is necessary because they tend to forget instructions over time.

Keywords

Asthma, elderly, non-elderly, inhalers, inhaler technique

Keywords

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Acronym List

ARL	Aerolizer®
BZL	Breezhaler®
CES-D	Centre for Epidemiological Studies Depression Scale
CHCB	Centro Hospitalar Cova da Beira
COPD	Chronic Obstructive Pulmonary Disease
DK	Diskus®
DPI	Dry Powder Inhalers
GDS-15	Geriatric Depression Scale
ICS	Inhaled Corticosteroid
LABA	Long Action Beta Agonist
LOA	Late onset asthma
LSA	Long standing asthma
MDI	Metered-Dose Inhalers
MHL	Miat-Haler®
MMSE	Mini-Mental State Examination
NVL	Novolizer®
p	*p*-value
SABA	Short Action Beta Agonist
SD	Standard deviation
SPM	Spiromax®
SPSS	Statistical Package for the Social Sciences
TH	Turbohaler®
TWL	Twisthaler®
VAS	Visual Analogic Scales

1. Introduction

Asthma is a chronic airway inflammatory disease associated with bronchial hyper responsiveness to various triggers, causing variable airflow limitation.[1] It is defined by a history of respiratory symptoms such as wheeze, dyspnoea, chest tightness and cough that vary over time.[1]

Asthma is common, affecting approximately 300 million people worldwide. It represents a serious health problem, not only due to increasing prevalence but also because of high direct and indirect costs.[1] The fourth National Health Inquiry found that 5.5% of the Portuguese population had an asthma diagnosis, with 42% of the patients being male (18.5% elderly) and 58% female (26.7% elderly).[2]

Although asthma has no cure, it can be effectively treated and controlled. Thus, every patient should have a reliever and a controller medication, initiated as soon as possible after diagnosis and adjusted in a stepwise approach.[1] The best way to deliver this medication is through an inhaled route as it maximizes therapeutic effect and minimizes side effects.[3] Thus, two types of inhalers are used, metered-dose inhalers (MDI) and dry powder inhalers (DPI).[4] In order to achieve optimal lung delivery, it is necessary to use inhalers following a specific sequence of steps.[5] In this way, alongside appropriate medication, a correct inhalational technique is essential for effective asthma therapy,[6] or as Fink and Rubin stated, management is 10% medication and 90% education[7].

Incorrect inhaler technique is frequent, with 4-94% of asthmatics using inhalers inappropriately, depending on the type of inhaler and method of assessment,[8] assuming an even greater proportion in the elderly due to lower lung capacities and cognitive impairment[9]. The use of several inhalers can also increment error.[10, 11] This leads to suboptimal treatment and lack of asthma control, stepping up to higher doses or prescribing additional therapies in patients who could be managed with their current medication.[5, 12] To overcome this and due to high error rates associated with MDI, DPI have been proposed as more elderly-appropriate.[4] However, even DPI present a high percentage of mishandling.[13] Guidelines focus on pharmaceutical treatment[14] and provide little information regarding inhaler choice and inhaler technique[15]. Thus, as there is no clear advantage of a particular system over another, it is proposed that MDI and DPI are clinically equivalent if used correctly.[16] In this way, prescription must take into account patient needs, situation and preference.[16]

Inhaler technique education is essential in reducing mishandling.[17] As many as 25% of patients never received inhaler training and, in those that do, quality and duration of training is

inadequate and not reinforced frequently.[8, 18] Furthermore, physicians often underestimate mishandling,[8] often prescribing devices, assuming correct usage, whereas the majority of patients does not realize that therapy efficacy depends on their technique[16]. In addition, since patients do not maintain a correct use over time,[19] it is important to assess inhaler technique frequently. Thus, physicians have a major role in accomplishing optimal therapeutic effect, both in achieving initial correct technique and in maintaining correct use.[5] Several inhaler training techniques have been studied and it was found that the best way to acquire a correct use is through verbal/written counselling associated with practical demonstration.[18] It is not sufficient to ask patients whether they know how to use their inhalers, and, in fact, practical demonstration is necessary because they tend to over-estimate their performance.[20]

This study hypothesizes that the elderly have a higher amount of inhaler technique errors compared to the non-elderly, with education and inhaler training as determinants of correct technique. It also proposes the existence of an inconsistency between self-perception and real inhaler handling performance. Thus, it aims to: 1) Compare inhaler technique error frequency and type between elderly and non-elderly asthmatic patients; 2) Compare inhaler technique self-perception with real performance and 3) Evaluate factors influencing inhaler technique in each age group.

2. Materials and Methods

2.1. Study Design and Sample Selection

This was a cross-sectional, observational study, carried out at the Immunoallergology and Pulmonology outpatient clinics of Centro Hospitalar Cova da Beira (CHCB) in Covilhã, Portugal, from March 2015 to March 2016. The target population included individuals with a confirmed clinical diagnosis of asthma. The sample was divided into two groups according to age: elderly (≥65 years) and non-elderly (18-64 years). The main study outcome was percentage of major errors and secondary outcomes were percentage of minor errors, specific inhaler technique steps and factors affecting inhaler technique. Based upon the main variable of interest, and in view of the results from similar studies carried out elsewhere,[4, 5, 8, 10, 20] we estimated that we would need at least 90 elderly and 90 non-elderly asthmatic patients to be able to detect a difference in major errors in the inhalational technique with a margin of error of less than 5% and a 95% confidence interval. Possible confounders were patients with cognitive impairment and other allergic or respiratory diseases that could resemble asthma presentation. In order to overcome this, patients with cognitive impairment and chronic obstructive pulmonary disease (COPD) were excluded. Also, it was assured that both study populations were well matched. The study protocol was approved by the CHCB ethics committee and conducted in accordance with the declaration of Helsinki.

2.2. Patient Recruitment

Patients were invited to participate in the study by a telephone call. Those we failed to contact upon three attempts on different days, were excluded. The patients who agreed to participate were assessed at CHCB after signing a written informed consent (Appendix I) upon explanation of the study.

2.3. Definitions

In this study, childhood onset asthma involved the development of asthma symptoms and a confirmed bronchial asthma before 18 years of age whereas adult onset asthma was defined when symptoms of asthma developed after that age.

Atopy was defined as the presence of at least one positive cutaneous response (> 3 mm) to aeroallergens and/or a positive serum test for screening aeroallergen-specific IgE (> 0.35 kUA/L). The in vitro test for determination of serum values of IgE specific for the standard screening battery of aeroallergens (Phadiatop aeroallergens) was performed using a fluorometric methodology (Unicap 100 Phadia Diagnosis®, Phadia, Sweden).

2.4. Questionnaires

A standardized questionnaire was used to collect data on sociodemographic and clinical aspects (Appendix II). The Geriatric Depression Scale (GDS-15) was used to assess depression symptoms in the elderly[21] (Appendix III) whereas the Centre for Epidemiological Studies Depression Scale (CES-D) was used to asses depression in the non-elderly[22] (Appendix IV). The Mini-Mental State Examination (MMSE) questionnaire was used to screen for cognitive compromise according to education level (Appendix V).[23] All questionnaires were validated for the Portuguese population with high reliability and validity values.[21-23]

In order to assess inhaler technique, a standardized questionnaire was applied to all volunteers (Appendix VI). First, the participant answered nine multiple-choice questions. Current reliever ("Which inhaler do you use in an asthma crisis?") and controller medication ("Which inhaler do you use for regular treatment?") were asked, with possible answers being short action beta agonist (SABA), long action beta agonist (LABA), inhaled corticosteroid (ICS) or none. Self-perception of difficulty in using an inhaler was assessed using the question "Which do you think is your degree of difficulty in handling inhaled devices?", with possible answers being easy, moderate or hard. Self-perception in correct use ("Do you think your inhaler technique is correct?"), inhaler technique training ("Did you have inhaler technique training?"), inhaler usage verification ("Did anyone check your inhaler technique?") and frequent verification ("Is you inhaler technique regularly checked?") were assessed with polar questions. Who trained the patient using his inhaler was also asked ("if yes, by whom?") with possible answers being physician, nurse, pharmacist or relative. Finally, how the technique was checked ("if yes, how is it checked?") was also asked with possible answers being demonstrated by the professional or patient requested exemplification. Using Visual Analogue Scales (VAS), the volunteer was asked about his self-perception of inhaler technique ("I perform my inhaler technique correctly"), satisfaction with the inhaler ("I feel satisfied with my inhaler"), including comfort in public use ("I feel comfortable using my inhaler in public") and perception of own preference being taken into account at inhaler prescription ("I feel that my physician took my preferences into account when choosing my inhaler").

At a second phase, the participant was asked to demonstrate his/her usual inhaler technique, using a placebo inhaler. The inhaler technique was evaluated using checklists based on manufacturers' instructions registered with the Portuguese drug agency database (Infarmed), for MDI, Turbohaler® (TH), Diskus® (DK), Aerolizer® (ARL), Novolizer® (NVL), Miat-Haler® (MHL), Breezhaler® (BZL), Spiromax® (SPM) and Twisthaler® (TWL). All errors were recorded in accordance with previously defined criteria for major and minor errors.[5] The technique was classified as correct if no errors were detectable, acceptable if at least one minor error was detectable and incorrect if at least one major error was detectable. As it was possible for one patient to have more than one inhaler, performance for different inhalers in the same

individual was independently assessed and evaluated. At a third phase, correct inhaler technique was explained and demonstrated by the interviewer, for future reference.

2.5. Lung Function - Spirometry

Spirometry was performed in volunteers without episodes of respiratory infections in the previous four weeks, with the patients sitting down, using the EasyOne spirometer (ndd Medical Technologies, Andover, MA, USA) before and 15 minutes after inhalation of 200 mg of a SABA (salbutamol), via MDI and a spacer chamber. Only spirometric tests which met the American Thoracic Society / European Respiratory Society criteria were used for analysis. When bronchial obstruction was detected, bronchodilation was carried out and a positive response was recorded in the presence of an increase in FEV1 of at least 200 ml and 12%.

2.6. Statistical Analysis

Data was analysed using the Statistical Package for the Social Sciences (SPSS), version 23.0 software. Descriptive analysis was used for sample characterization. Chi-Square Test and Fischer's Exact Test were used for comparative analysis of nominal variables and Mann-Whitney U Test was used for quantitative variables in both study groups. P-value (p) equal or less than 0.05 was regarded statistically significant in all tests. Missing data was approached by restricting analysis to individuals with complete data.

3. Results

3.1. Sample selection and characterization

In this study, out of a list of 112 elderly patients meeting the criteria for entry into the study, 4 refused to participate, and we were not able to contact 11, even upon three attempts. Five elderly asthmatics had to be excluded, one due to low MMSE score, two due to COPD comorbidity and two due to questionnaire loss, originating a total number of 92 elderly asthmatics participating in the study. In terms of non-elderly asthmatics, out of a list of 104, we were able to contact 100. Thus, 100 non-elderly and 97 elderly individuals with a confirmed clinical diagnosis of asthma followed in CHCB outpatient clinics were interviewed (Figure 1).

As 71 non-elderly asthmatics had one inhaler, 28 had two inhalers and 1 had three inhalers, total inhaler technique demonstrations in this group were 130. Likewise, 58 elderly asthmatics had one inhaler, 27 had two inhalers and 2 had three inhalers, originating a total 118 inhaler demonstrations in this group, although five elderly had no inhaler and were not included in inhaler technique analysis.
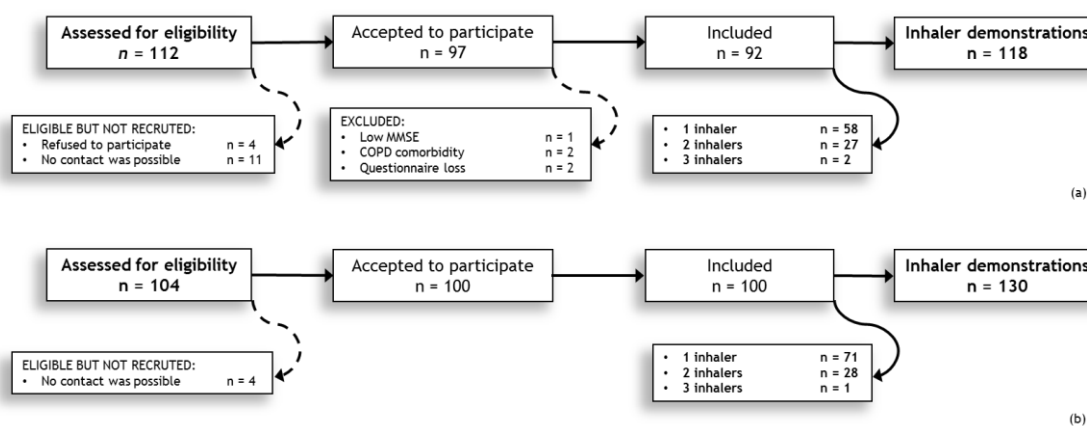
Figure 1 - Patient selection flow diagram. (a) Elderly and (b) Non-elderly.

3.2. Sociodemographic caracterization

Sociodemographic population characteristics are shown in Table 1. The mean age in the elderly group was 72.9 years (ranging from 65 to 86 years) and there was a clear female predominance (82.6%). In this group, the great majority of patients had a low education level (4 years or less), low social class (class IV on Graffar scale) and lived in an urban setting. In the non-elderly, the mean age was 45.2 years, ranging from 19 to 64 years, also with a clear female predominance (81.0%). This group had a significantly higher education level, with most individuals having 9 years or more of schooling, and a significantly higher social class,

most classifying as class III on Graffar scale. A higher proportion lived in an urban environment, although this did not reach statistical significance.

It should be highlighted that none of the patients had cognitive impairment on the MMSE, as this was an exclusion criteria. Most elderly asthmatics (70.7%) had no depressive humor on the GDS used to screen this population and even in those with depressive humor, only a minority (3.3%) had a severe impairment. Likewise, the majority of the non-elderly patients (73.0%) had no depressive humor on the CES-D scale used to screen this group.

Table 1 - Sociodemographic characterization.

		Non-Elderly (n=100)	Elderly (n=92)	P [a]
Age (years)	Mean ± SD (max, min)	45.2 ± 13.2 (19, 64)	72.9 ± 5.5 (65, 86)	-
Gender	Male Female	19 (19.0%) 81(81.0%)	16 (17.4%) 76 (82.6%)	0.773
Schooling	No schooling 4 years 5-9 years 10-12 years >12 years	2 (2.0%) 21 (21.0%) 23 (23.0%) 28 (28.0%) 26 (26.0%)	5 (5.4%) 67 (72.8%) 10 (10.9%) 6 (6.5%) 4 (4.3%)	<0.001
Residence	Rural Urban	37 (37.0%) 63 (63.0%)	43 (46.7%) 49 (53.3%)	0.215
Graffar	Class I Class II Class III Class IV Class V	11 (11.0%) 25 (25.0%) 50 (50.0%) 14 (14.0%) 0 (0.0%)	0 (0.0%) 5 (5.4%) 24 (26.1%) 63 (68.5%) 0 (0.0%)	<0.001
MMSE	Without cognitive defect With cognitive defect	100 (100.0%) 0 (0.0%)	92 (100.0%) 0 (0.0%)	-
CES-D	Without depression With depression	73 (73.0%) 27 (27.0%)	-	-
GDS	Normal Mildly depressed Severely depressed	-	65 (70.7%) 24 (26.1%) 3 (3.3%)	-

[a] Chi-Square Test

3.3. Clinical caracterization

Clinical characteristics of the patient sample are shown in Table 2. There was a significant difference between both groups, in terms of atopy, with a clearly higher proportion of non-elderly asthmatics than elderly asthmatics being atopic (80% versus 19.6%, respectively). The most frequent allergic comorbidity was rhinitis (76.0% of the non-elderly compared to 58.7% of the elderly). The most common non-allergic comorbidity, in both groups, was arterial hypertension, although it was much more prevalent in the elderly (62.0% compared to 21.0%). The second most common comorbidity was gastro-oesophageal reflux in the non-elderly (9.0%) and diabetes mellitus in the elderly (16.3%).

Almost all patients were on an ICS. SABA and leukotriene receptor antagonists were prescribed more frequently in the non-elderly whereas LABA was more prevalent in the elderly. In terms of the number of inhalers used by each patient, there were no significant differences between groups.

The most frequent inhalers used by patients were MDI, TH and DK in both groups, although frequency varied for individual type. ARL, NVL, MHL, BZL, SPM and TWL were used only by a minority of asthmatics. In the non-elderly patients, the most frequent inhaler was MDI (46.0%), closely followed by TH (43.0%) with DK being the least prevalent (21.0%). In contrast, in the elderly, the most used inhaler was DK (44.6%), followed by TH (31.5%) and MDI (28.3%).

Table 2 – Clinical population characterization.

		Non-Elderly (n=100)	Elderly (n=92)	P
Atopy	Atopic	80 (80.0%)	18 (19.6%)	**0.009**[a]
	Non-atopic	20 (20.0%)	74 (80.4%)	
Asthma Onset	Childhood (<18 years old)	37 (37.0%)	20 (21.7%)	**0.021**[a]
	Adult (>18 years old)	63 (63.0%)	72 (78.3%)	
Family history	Respiratory disease	48 (48.0%)	44 (47.8%)	0.981[a]
	Allergies	43 (43.0%)	20 (21.7%)	**0.002**[a]
Comorbidities	Rhinitis	76 (76.0%)	54 (58.7%)	**0.01**[a]
	Obstructive Sleep Apnoea	1 (1.0%)	4 (4.3%)	0.196[c]
	Cardiac failure	0 (0.0%)	7 (7.6%)	**0.005**[c]
	Diabetes mellitus	7 (7.0%)	15 (16.3%)	**0.043**[a]
	Gastro-esophageal Reflux	9 (9.0%)	10 (10.9%)	0.665[a]
	Arterial Hypertension	21 (21.0%)	57 (62.0%)	**<0.001**[a]
Therapy	SABA	75 (75.0%)	41 (44.6%)	**<0.001**[a]
	LABA	41 (41.0%)	60 (65.2%)	**0.001**[a]
	ICS	91 (91.0%)	86 (93.5%)	0.523[a]
	Leukotriene Antagonist	49 (49.0%)	24 (26.1%)	**0.001**[a]
	Theophylline	3 (3.0%)	6 (6.5%)	0.316[c]
	Oral Corticosteroid	6 (6.0%)	5 (5.4%)	0.866[a]
	Anti-IgE Therapy	0 (0.0%)	2 (2.2%)	0.228[c]
Number of Inhalers	none	0 (0.0%)	5 (5.4%)	0.072[c]
	1 inhaler	71 (71.0%)	58 (63.0%)	
	2 inhalers	28 (28.0%)	27 (29.3%)	
	3 inhalers	1 (1.0%)	2 (2.2%)	
Inhaler type	MDI	46 (46.0%)	26 (28.3%)	**0.011**[a]
	TH	43 (43.0%)	29 (31.5%)	0.101[a]
	DK	21 (21.0%)	41 (44.6%)	**<0.001**[a]
	ARL	7 (7.0%)	13 (14.1%)	0.106[a]
	NVL	2 (2.0%)	0 (0.0%)	0.498[c]
	MHL	10 (10.0%)	4 (4.4%)	0.132[a]
	BZL	0 (0.0%)	3 (3.3%)	0.108[c]
	SPM	0 (0.0%)	2 (2.2%)	0.228[c]
	TWL	1 (1.0%)	0 (0.0%)	1.00[c]

Lung Function	FEV1 (L/min)
	  Mean + SD
	  Median (max, min)
		2.60 + 0.64
		2.55 (1.74, 4.31)
			1.72 + 0.53
			1.68 (0.87, 3.19)
				<0.001[b]

	FEV1 (%)
	  Mean + SD
	  Median (max, min)
		104.2 + 16.2
		103.1 (70.0, 147.2)
			101.9 + 25.7
			104.6 (40.3, 141.5)
				0.833[b]

	VFC (L/min)
	  Mean + SD
	  Median (max, min)
		3.36 + 0.80
		3.25 (1.74, 5.87)
			2.42 + 0.64
			2.38 (1.28, 4.24)
				<0.001[b]

	VFC (%)
	  Mean + SD
	  Median (max, min)
		113.9 + 16.0
		112.3 (77.5, 147.2)
			114.9 + 21.9
			117.6 (74.0, 150.2)
				0.772[b]

	Patients with obstruction
	  Mild
	  Moderate
	  Severe
		100 (100.0%)
		0 (0.0%)
		0 (0.0%)
			67 (72.8%)
			17 (18.5%)
			8 (8.7%)
				<0.001[c]

	Patients with reversibility	71 (71.0%)	22 (24.3%)	**<0.001**[a]

[a] Chi-Square Test; [b] Mann-Whitney U Test; [c] Fisher Exact Test

3.4. Inhaler technique

First, we wanted to see if inhaler technique was different between the elderly and the non-elderly asthmatics (Table 3). Considering all devices, technique was correct in a similar proportion of elderly (13.6%) and non-elderly (15.4%) asthmatics. Performance was acceptable, with only minor errors, in 55.4% of the younger asthmatics compared to 61.0% of the older population. Finally, and most importantly, an incorrect demonstration, with major errors, occurred in 29.2% of the non-elderly compared to 25.4% of the elderly. MDI was the inhaler associated with the worst performance in both study groups, demonstrating high proportion of major errors (42.3% in the elderly compared to 37.0% in the non-elderly). In contrast, DK was the inhaler associated with the lowest proportion of major errors and the highest proportion of minor errors. No difference was found between study groups for inhaler technique with any device.

Table 3 – Comparison of Inhaler performance between elderly and non-elderly patients.

		Non-Elderly (n=130)	Elderly (n=118)	p
TOTAL	Correct Technique	20 (15.4%)	16 (13.6%)	
	Acceptable Technique	72 (55.4%)	72 (61.0%)	0.668[a]
	Incorrect Technique	38 (29.2%)	30 (25.4%)	
MDI	Correct Technique	9 (19.6%)	2 (7.7%)	
	Acceptable Technique	20 (43.5%)	13 (50.0%)	0.477[b]
	Incorrect Technique	17 (37.0%)	11 (42.3%)	
TH	Correct Technique	5 (11.6%)	3 (10.3%)	
	Acceptable Technique	29 (67.4%)	19 (65.5%)	0.935[b]
	Incorrect Technique	9 (20.9%)	7 (24.1%)	
DK	Correct Technique	4 (19.0%)	5 (12.2%)	
	Acceptable Technique	14 (66.7%)	28 (68.3%)	0.782[b]
	Incorrect Technique	3 (14.3%)	8 (19.5%)	
ARL	Correct Technique	1 (14.3%)	4 (30.8%)	
	Acceptable Technique	5 (71.4%)	9 (69.2%)	0.548[b]
	Incorrect Technique	1 (14.3%)	0 (0.0%)	
NVL	Correct Technique	1 (50.0%)	0 (0.0%)	
	Acceptable Technique	1 (50.0%)	0 (0.0%)	-
	Incorrect Technique	0 (0.0%)	0 (0.0%)	
MHL	Correct Technique	0 (0.0%)	0 (0.0%)	
	Acceptable Technique	2 (20.0%)	2 (50.0%)	0.520[b]
	Incorrect Technique	8 (80.0%)	2 (50.0%)	
BZL	Correct Technique	0 (0.0%)	1 (33.3%)	
	Acceptable Technique	0 (0.0%)	1 (33.3%)	-
	Incorrect Technique	0 (0.0%)	1 (33.3%)	
SPM	Correct Technique	0 (0.0%)	0 (0.0%)	
	Acceptable Technique	0 (0.0%)	1 (50.0%)	-
	Incorrect Technique	0 (0.0%)	1 (50.0%)	
TWL	Correct Technique	0 (0.0%)	0 (0.0%)	
	Acceptable Technique	1 (100.0%)	0 (0.0%)	-
	Incorrect Technique	0 (0.0%)	0 (0.0%)	

[a] Chi-Square Test; [b] Fisher Exact Test

Next, we wanted to check whether there was a different distribution of errors according to technique step between elderly and non-elderly asthmatics. Table 4 lists the detailed performance in each step for the three most common inhalers encountered in this study. The remaining inhalers were used too infrequently to allow drawing any conclusions. For all three inhalers, the step most frequently missed in both study groups was a minor error, consisting of failure to tilt the head back when inhaling, with no difference between elderly and non-

elderly asthmatics. Similar percentages of errors at each step were found between elderly and non-elderly patients, with the exception of failure to place MDI mouthpiece correctly and failure to exhale slowly after DK inhalation, associated with a higher proportion of error in the elderly compared to the non-elderly asthmatics.

Table 4 - Detailed step errors for MDI, TH and DK.

		Non-Elderly		Elderly		*p*
		Correct	Incorrect	Correct	Incorrect	
MDI	Shakes the inhaler[a]	35 (79.5%)	9 (20.5%)	18 (72.0%)	7 (28.0%)	0.475[c]
	Removes the lid[a]	44 (100.0%)	0 (0.0%)	25 (100.0%)	0 (0.0%)	-
	Exhales[b]	31 (70.5%)	13 (29.5%)	15 (60.0%)	10 (40.0%)	0.376[c]
	Tilts the head back[b]	15 (34.1%)	29 (65.9%)	7 (28.0%)	18 (72.0%)	0.602[c]
	Places the mouthpiece correctly[a]	44 (100.0%)	0 (0.0%)	22 (88.0%)	3 (12.0%)	**0.012[d]**
	Simultaneously presses the inhaler and breathes in[a]	37 (84.1%)	7 (15.9%)	22 (88.0%)	3 (12.0%)	0.654[d]
	Inhales slowly and deeply[a]	36 (81.8%)	8 (18.2%)	21 (84.0%)	4 (16.0%)	0.817[c]
	Removes the inhaler	44 (100.0%)	0 (0.0%)	25 (100.0%)	0 (0.0%)	-
	Maintains chest full of air for ten seconds[b]	22 (50.0%)	22 (50.0%)	14 (56.0%)	11 (44.0%)	0.632[c]
	Exhales slowly with semi-closed lips[b]	28 (63.6%)	16 (36.4%)	15 (60.0%)	10 (40.0%)	0.764[c]
	Places the lid	44 (100.0%)	0 (0.0%)	25 (100.0%)	0 (0.0%)	-
TH	Removes the lid[a]	40 (95.2%)	2 (4.8%)	28 (100.0%)	0 (0.0%)	0.140[d]
	Rotates base clockwiset[a]	40 (95.2%)	2 (4.8%)	24 (85.7%)	4 (14.3%)	0.168[d]
	Rotates base counterclockwise until a click is heard[a]	35 (83.3%)	7 (16.7%)	23 (82.1%)	5 (17.9%)	0.897[d]
	Breathes out the air[b]	26 (61.9%)	16 (38.1%)	17 (60.7%)	11 (39.3)	0.920[c]
	Tilts the head back[b]	13 (31.0%)	29 (69.0%)	7 (25.0%)	21 (75.0%)	0.589[c]
	Places the mouthpiece[a]	41 (97.6%)	1 (2.4%)	26 (92.9%)	2 (7.1%)	0.341[d]
	Inhales quickly and strongly[a]	37 (88.1%)	5 (11.9%)	25 (89.3%)	3 (10.7%)	0.878[d]
	Removes the inhaler	41(97.6%)	1 (2.4%)	26 (92.9%)	2 (7.1%)	0.341[d]
	Maintains chest full of air for ten seconds[b]	26 (61.9%)	16 (38.1%)	18 (64.3%)	10 (35.7%)	0.840[c]
	Exhales slowly with semi-closed lips[b]	20 (47.6%)	22 (52.4%)	17 (60.7%)	11 (39.3%)	0.282[c]
	Places the lid	42 (100.0%)	0 (0.0%)	27 (96.4%)	1 (3.6%)	0.173[d]
DK	Pushes thumb grip back[a]	21 (100.0%)	0 (0.0%)	41 (100.0%)	0 (0.0%)	-
	Pushes lever back[a]	20 (95.2%)	1 (4.8%)	38 (92.7%)	3 (7.3%)	0.691[d]
	Breathes out the air[b]	14 (66.7%)	7 (33.3%)	20 (48.8%)	21 (51.2%)	0.180[c]
	Tilts the head back[b]	5 (23.8%)	16 (76.2%)	8 (19.5%)	33 (80.5%)	0.696[d]
	Places the mouthpiece[a]	20 (95.2%)	1 (4.8%)	41 (100.0%)	0 (0.0%)	0.138[d]
	Inhales quickly and strongly[a]	20 (95.2%)	1 (4.8%)	36 (87.8%)	5 (12.2%)	0.323[d]
	Removes the inhaler	21 (100.0%)	0 (0.0%)	40 (97.6%)	1 (2.4%)	0.671[d]
	Maintains chest full of air for ten seconds[b]	15 (71.4%)	6 (28.6%)	24 (52.5%)	17 (41.5%)	0.320[c]
	Exhales slowly with semi-closed lips[b]	15 (71.4%)	6 (28.6%)	16 (39.0%)	26 (61.0%)	**0.016[c]**
	Places the lid	21 (100.0%)	0 (0.0%)	37 (90.2%)	4 (9.8%)	0.063[d]

[a] Major error; [b] Minor error; [c] Chi-square test; [d] Fisher exact test

3.5. Auto-perception of inhaler handling

Next, we aimed to study the relationship between perceived device handling difficulty and inhaler technique (Table 5). Similar perceived difficulty was found in both populations of asthmatics. In the elderly, 84.7% classified their device as easy compared to 84.6% of the non-elderly. A significant association was found between perceived difficulty and inhaler technique in both study groups.

Only 13.0% of the elderly who classified device manipulation as easy had a totally correct technique, comparatively to a higher 18.2% in the non-elderly. Sixty six percent of the elderly who perceived their handling as easy showed minor errors in their handling, compared to a lower 57.3% in the younger population. Finally, 21.0% of the elderly who considered their device easy demonstrated major errors compared to 24.5% of the non-elderly. A comparison between both groups was made to understand if individuals who perceived difficulty as easy had a better observed performance. However, no difference was found ($p = 0.400$).

Table 5 – Relationship between perceived difficulty and technique.

		Perceived difficulty				P [a]
		Easy	Moderate	Hard	Don't Know	
Non-Elderly (n=130)	Correct Technique	20 (18.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.031
	Acceptable Technique	63 (57.3%)	8 (57.1%)	1 (20.0%)	0 (0.0%)	
	Incorrect Technique	27 (24.5%)	6 (42.9%)	4 (80.0%)	1 (100.0%)	
	Total	110 (84.6%)	14 (10.8%)	5 (3.8%)	1 (0.8%)	
Elderly (n=118)	Correct Technique	13 (13.0%)	1 (11.1%)	2 (25.0%)	0 (0.0%)	0.047
	Acceptable Technique	66 (66.0%)	4 (44.4%)	2 (25.0%)	0 (0.0%)	
	Incorrect Technique	21 (21.0%)	4 (44.4%)	4 (50.0%)	1 (100.0%)	
	Total	100 (84.7%)	9 (7.6%)	8 (6.8%)	1 (0.8%)	

[a] Fisher Exact Test

We further wanted to analyse if the elderly had a more pronounced difference between perceived performance and technique (Table 6). Both study groups tended to estimate their performance as correct (93.2% in the elderly compared to 84.6% in the non-elderly). However, no significant association was found between perceived performance and observed technique.

Table 6 – Relationship between perceived performance and technique.

		Perceived performance			P [a]
		Correct	Incorrect	Don't Know	
Non-Elderly (n=130)	Correct Technique	19 (17.3%)	0 (0.0%)	1 (5.9%)	0.082
	Acceptable Technique	64 (58.2%)	1 (33.3%)	7 (41.2%)	
	Incorrect Technique	27 (24.5%)	2 (66.7%)	9 (52.9%)	
	Total	110 (84.6%)	3 (2.3%)	17 (13.1%)	
Elderly (n=118)	Correct Technique	14 (12.7%)	0 (0.0%)	2 (40.0%)	0.328
	Acceptable Technique	67 (60.9%)	3 (100.0%)	2 (40.0%)	
	Incorrect Technique	29 (26.4%)	0 (0.0%)	1 (20.0%)	
	Total	110 (93.2%)	3 (2.5%)	5 (4.2%)	

[a] Fisher Exact Test

3.6. Inhaler Training

Next, we analysed the relationship between initial inhaler training and observed inhaler technique (Table 7). Almost all patients received initial inhaler training. However, only a minority (13.7%) of the elderly who had initial training showed a completely correct technique, with 60.7% showing minor errors and 25.6% demonstrating major errors. No significant association was found between receiving initial training and better technique in any group.

Table 7 - Relationship between initial inhaler training and technique.

		Initial Training		P [a]
		Yes	No	
Non-Elderly (n=130)	Correct Technique	20 (15.7%)	0 (0.0%)	1.00
	Acceptable Technique	70 (55.1%)	2 (66.7%)	
	Incorrect Technique	37 (29.1%)	1 (33.3%)	
	Total	127 (97.7%)	3 (2.3%)	
Elderly (n=118)	Correct Technique	16 (13.7%)	0 (0.0%)	1.00
	Acceptable Technique	71 (60.7%)	1 (100.0)	
	Incorrect Technique	30 (25.6%)	0 (0.0%)	
	Total	117 (99.2%)	1 (0.8%)	

[a] Fisher Exact Test

We next analyzed whether there was a relationship between frequency of inhaler training and observed inhaler technique (Table 8). Only 49.2% of the elderly and 55.4% of the non-elderly received frequent training. Nineteen percent of the elderly showed major errors compared to 20.8% in the non-elderly and 62.1% showed minor errors compared to 56.9%. Overall, frequent training had significantly more impact upon inhaler technique in the non-elderly than in the elderly.

Table 8 - Relationship between frequent inhaler training and technique.

		Frequent Training		P [a]
		Yes	No	
Non-Elderly (n=130)	Correct Technique	16 (22.2%)	4 (6.9%)	0.012
	Acceptable Technique	41 (56.9%)	31 (53.4%)	
	Incorrect Technique	15 (20.8%)	23 (39.7%)	
	Total	72 (55.4%)	58 (44.6%)	
Elderly (n=118)	Correct Technique	11 (19.0%)	5 (8.3%)	0.114
	Acceptable Technique	36 (62.1%)	36 (60.0%)	
	Incorrect Technique	11 (19.0%)	19 (31.7%)	
	Total	58 (49.2%)	60 (50.8%)	

[a] Chi-Square Test

We next analysed the relationship between different training methods and observed technique (Table 9). Forty five percent of the elderly and 46.6% of the non-elderly received frequent training by watching the healthcare professional handling the inhaler while 55.0% of the elderly and 39.7% of the non-elderly received training by device handling by the patient. No significant association was found between different training methods and inhaler technique.

Table 9 - Relationship between training methods and technique.

		Training method			P [a]
		Shown by professional	Shown by patient	Both	
Non-Elderly (n=72)	Correct Technique	5 (14.7%)	9 (31.0%)	2 (20.0%)	0.127
	Acceptable Technique	18 (52.9%)	15 (51.7%)	8 (80.0%)	
	Incorrect Technique	11 (32.4%)	5 (17.2%)	0 (0.0%)	
	Total	34 (46.6%)	29 (39.7%)	10 (13.7%)	
Elderly (n=58)	Correct Technique	6 (22.2%)	6 (18.2%)	0 (0.0%)	0.151
	Acceptable Technique	19 (70.4%)	18 (54.5%)	0 (0.0%)	
	Incorrect Technique	2 (7.4%)	9 (27.3%)	0 (0.0%)	
	Total	27 (45.0%)	33 (55.0%)	0 (0.0%)	

[a] Fisher Exact Test

3.7. Technique Determinants

We subsequently studied which factors might have an impact upon the inhalational technique and whether these were different between elderly and non-elderly patients (Table 10). No significant association was found between inhaler technique and gender, schooling, social class or number of inhalers in any of the study groups.

Table 10 - Factors influencing inhaler technique.

	Non-Elderly (n=130)			P [a]	Elderly (n=118)			P [a]
	Correct Technique	Acceptable Technique	Incorrect Technique		Correct Technique	Acceptable Technique	Incorrect Technique	
Gender				0.866				0.057
Male	3 (12.0%)	15 (60.0%)	7 (28.0%)		9 (9.2%)	63 (64.3%)	26 (26.5%)	
Female	17 (16.2%)	57 (54.3%)	31 (29.5%)		6 (30.0%)	10 (50.0%)	4 (20.0%)	
Schooling				0.065				0.960
None	0 (0.0%)	2 (50.0%)	2 (50.0%)		1 (20.0%)	3 (60.0%)	1 (20.0%)	
4 years	1 (3.4%)	22 (75.9%)	6 (20.7%)		12 (14.1%)	51 (60.0%)	22 (25.9%)	
4-9 years	9 (30.0%)	15 (50.0%)	6 (20.0%)		2 (14.3%)	9 (64.3%)	3 (21.4%)	
9-12 years	4 (11.8%)	19 (55.9%)	11 (32.4%)		0 (0.0%)	7 (77.8%)	2 (22.2%)	
>12 years	6 (18.2%)	14 (42.4%)	13 (39.4%)		0 (0.0%)	3 (60.0%)	2 (40.0%)	
Graffar				0.256				0.343
Class I	4 (30.8%)	4 (30.8%)	5 (38.5%)		0 (0.0%)	0 (0.0%)	0 (0.0%)	
Class II	3 (9.1%)	19 (57.6%)	11 (33.3%)		0 (0.0%)	4 (66.7%)	2 (33.3%)	
Class III	12 (18.8%)	35 (54.7%)	17 (26.6%)		1 (3.7%)	17 (63.0%)	9 (33.3%)	
Class IV	1 (5.0%)	14 (70.0%)	5 (25.0%)		14 (16.5%)	52 (61.2%)	19 (22.4%)	
Class V	0 (0.0%)	0 (0.0%)	0 (0.0%)		0 (0.0%)	0 (0.0%)	0 (0.0%)	
Inhalers				0.573				0.504
1 inhaler	13 (18.3%)	35 (49.3%)	23 (32.4%)		7 (12.5%)	34 (58.6%)	17 (29.3%)	
2 inhalers	7 (12.5%)	35 (62.5%)	14 (25.0%)		8 (14.8%)	33 (61.1%)	13 (24.1%)	
3 inhalers	0 (0.0%)	2 (66.7%)	1 (33.3%)		0 (0.0%)	6 (100.0%)	0 (0.0%)	

[a] Fisher Exact Test

4. Discussion

In this cross-sectional, observational study, an approach to inhaler technique assessment applicable in clinical practice was used. A set of nine different inhalers were included, which makes it one of the largest studies in inhaler technique evaluation in Portugal and in the elderly. A similar study was carried out in Porto, in seaside Portugal,[13] in a population whose characteristics may be different from those in the current study. Also, the Porto study included patients with COPD and no comparison between elderly and non-elderly patients was made.

In our study, inhaler technique was correct in only a minority of patients. MDI was the inhaler associated with the worst performance and DK was the inhaler with the best performance. However, no difference was found between study groups. Elderly and non-elderly asthmatics showed similar errors at each step of inhaler usage with the exception of failure to place MDI mouthpiece correctly and failure to exhale slowly after DK inhalation. A significant association was found between perceived difficulty and inhaler technique in both study groups. However, no significant association was found between perceived performance and observed technique. Almost all patients received initial inhaler training. Nevertheless, no significant association was found between receiving initial training and better technique in any of the study groups. Only about half the patients received frequent inhaler training, although it seems to have more impact upon inhaler technique in the non-elderly. Still, no significant association was found between different training methods and inhaler technique. Finally, no significant association was found between inhaler technique and gender, schooling, social class or number of inhalers in any of the study groups.

The most frequent inhalers used by both elderly and non-elderly in this study were MDI, TH and DK. MDI was the inhaler most prescribed in the non-elderly whereas DK was the most common in the elderly. A high error rate and a corresponding low percentage of correct technique, with only 13.6% of the elderly and 15.4% of the non-elderly patients showing no mistakes in inhaler handling, was found. This is consistent with findings in Portugal,[13] throughout Europe, reviewed by Crompton et al,[15] but also in studies carried out outside of Europe[12, 20, 24, 25]. Several studies have proposed that mishandling is associated with poor clinical outcome.[26, 27] Thus, finding a low percentage of correct technique in this study is a matter for concern in clinical practice. However, in our study, the elderly patients did not show lower correct technique when compared with non-elderly patients, which is in disagreement with some studies that found an association between age and worse inhaler performance.[10, 13, 26, 28] This may be because none of these studies included patients older than 75 years old and no comparison was made between elderly and non-elderly asthmatics.

Also, some of these studies[13, 26] included patients with COPD and no comparison between age groups was made separately for both respiratory diseases. These studies were carried out in Italy,[26] Brazil,[10] Korea,[28] and seaside Portugal,[13] which represent different geographical and cultural environments from our study which may interfere with asthma technique. Finally, in our study, both elderly and non-elderly asthmatics had similar regular follow up with technique reinforcement, which may be responsible, at least in part, for similar technique handling between groups. Lack of difference between study groups was not attributed to differences in asthma treatment as ICS had similar usage and frequency in both groups.

Observational studies evaluating patients' abilities in inhaler handling are inconsistent, with some reporting mistakes more common with MDI than DPI,[13, 26, 29, 30] and other reporting a similar proportion of inhaler misuse with MDI and DPI[31, 32]. In this study, a lower proportion of correct technique and consequently a higher proportion of errors, was found with MDI compared to DPI, making this device less user friendly. DK was found as the inhaler with the highest correct technique and lowest error percentage in both populations, making it the most user friendly device. Thus, this study is consistent with findings that state DPI as having fewer errors than MDI.[13, 17, 20, 33] However, no difference was found between study groups for any inhaler.

The step most frequently missed for MDI, TH and DK was failure to tilt the head back when inhaling, a minor error performed by the great majority of patients, with no difference between study groups. Other minor errors such as failure in making a complete exhalation before inhalation, maintaining the chest full of air for ten seconds and failure to exhale slowly with semi-closed lips were also very common. These findings are consistent with results from previous studies.[8, 12, 24, 26]

Although lack of coordination between pressing the MDI and starting inhalation, a major error using MDI, is reported very commonly,[15] only a minority of asthmatics missed this step, with no difference between study groups. Thus, the most common major error using MDI was failure to shake the inhaler before usage. This may be due to lack of perception of the importance of this critical step in order to permit drug gas to be mobilized to the lungs. Another major error, failure to place the mouthpiece correctly with the container facing up and tightening lips around the mouthpiece, was significantly associated with worse performance in the elderly compared to the non-elderly. This may be due to many factors such as lower level of cognitive function, which determines the ability to learn a correct technique and retain it as well as lower motor coordination, which is essential for correct technique.[15]

The most common major error in manipulating TH was failure to rotate the inhaler base counterclockwise until hearing a click, with similar percentage of error in both groups. This might be due to lack of retaining the correct technique and confusion in terms of the right

direction in which to turn the device base. Using DK, the major error observed was failure to make a strong and rapid inhalation, a patient dependent error. This may be due to easier device handling compared to other inhalers, with fewer wrong steps in physical device performance. With DK, failure to exhale slowly with semi-closed lips, a minor error, was significantly more frequent in the elderly when compared to the non-elderly. Again, this may be due to lower ability to retain technique and lack of perception in the importance of this step.

These results suggest that, although MDI had the worst performance, all inhalers show a high error rate, which is consistent with guidelines stating that devices are equally efficacious if used correctly.[34] However, they are helpful in clinical practise so that physicians know in which steps to focus during technique reinforcement.

A significant association was found between perceived difficulty and inhaler technique. The great majority of asthmatics classified their inhalers as easy, with similar percentages between elderly and non-elderly (84.7% and 84.6%, respectively). However, only a minority (13.0%) of the elderly who classified their inhaler as easy had a totally correct technique, with 66.0% showing minor errors and 21.0% demonstrating major errors. Although a lower proportion of the elderly who regarded technique as easy showed a correct performance, no difference was found between study groups. Nevertheless, both elderly and non-elderly asthmatics made a lot of errors. Although no significant association was found between perceived device performance and inhaler technique in either study groups, a high percentage of patients tended to overestimate their technique as correct when compared to observed performance. These results suggest that there is a discrepancy between perception and real inhaler technique. Thus, in clinical practise, it is not sufficient to ask patients whether they know how to use their inhalers, and practical demonstration and technique correction are necessary because they tend to overestimate performance. Similar suppositions have been made in previous studies.[4, 20]

Although almost all patients received initial inhaler training, no association was found between initial training and better technique in any study group. Only a minority of both elderly and non-elderly patients who had initial training showed a correct technique (13.3% and 15.7%, respectively). This might be due to inhaler technique becoming inadequate over time if not assessed frequently even with initial training because patients tend to forget instructions.[19, 20]

In this study, only about half of both study groups received frequent inhaler training. This may be due to typical busy practise with insufficient time or inadequate materials to reinforce frequent training. Frequent assessment and demonstration was significantly associated with a better inhaler technique, with fewer minor and major errors, in the non-elderly but not in the elderly group. This might be due to lower cognitive function, naturally

occurring with age, becoming harder to retain technical information. Thus, more frequent assessment and demonstration are necessary in the elderly compared to the non-elderly for maintaining a correct performance over time. These results are consistent with previous studies[26, 27] and suggest that frequent inhaler technique evaluation is necessary to reduce mishandling.

No significant association was found between any training method and better performance. These results suggest that a combination of different training techniques is necessary in order to reduce both major and minor errors associated with inhaler mishandling. These include, verbal and written counselling associated with patient technique simulation and demonstration by healthcare staff, in order to correct errors.[18] Further studies are necessary to elucidate the impact of different inhaler training methods in the Portuguese asthmatic population.

In the literature there is no consensus about determinants of correct inhaler technique.[26] In this study, an attempt to clarify this matter was made. Gender impact in inhaler handling is a complex matter, with some studies finding no association,[26, 31, 35] some finding worse performance in female patients[13] and some finding worse performance in the male gender[28]. In this study, no association was found between gender and handling. Although lower education has been associated with worse inhaler technique in some studies,[10, 26, 28] no association with schooling was found in this study. This may be because, in our study, almost all elderly asthmatics had low schooling years (<9 years) and thus, comparison with higher schooling was not possible. Although the non-elderly showed a more evenly schooling distribution, lower cognitive impairment might be a possible confounder for technique. Social class influence on inhaler performance remains complex, with some studies finding no significant association,[28] while others suggest a relationship between lower social class and worse technique[17]. In this study, no association was found. Finally, although some studies suggest that having more than one inhaler was associated with worse inhaler performance,[11, 20] such association was not found in this study. Discrepancy between our study and other studies may be due to different population characteristics such as age and geographical region or differences in healthcare systems with different patient follow up and technique reinforcement. Thus, further studies are necessary to elucidate these relationships.

This study has some limitations that may hinder generalization. Not all devices available in the market were evaluated because some were used infrequently, although the most common were included and assessed. Findings in inhaler technique may be biased due to criteria chosen to define mishandling because no universal standardization has been made so far and error definition varies between studies, making study comparison difficult. Interviewer bias cannot be excluded because results concerning inhaler technique were based on investigators' judgment and, although coordination between investigators was attempted to reduce variability, a subjective bias may persist. Evaluating strength and speed inspiration

through observation is subjective, but represents a real clinical context where inspiratory flow measurement equipment is not available and decisions are based on observation alone. In training evaluation, how long had the last inhaler training session taken place was not asked, and, as such, influence of recent training on technique was not assessed. Furthermore, selection bias cannot be excluded because all patients were followed at a single healthcare institution.

In conclusion, incorrect inhaler technique remains common, although no difference was found between elderly and non-elderly. This is a reason for concern because it leads to suboptimal treatment and lack of control. In this study, MDI was found to have a higher proportion of errors and a lower percentage of correct technique when compared to DPI, suggesting it as less user friendly. However, no device was found superior to another concerning individual inhaler steps, consistent with guidelines stating devices as equivalent if handled correctly. Thus, when prescribing an inhaler, availability, clinical setting, cost, physician experience and ability to use the inhaler must be considered. Also, although inhaler technique is taught to almost all patients, errors remain common if no frequent training is ensured because patients, especially the elderly, tend to forget instructions over time. It is not sufficient to ask patients about their perception in device handling difficulty or performance because they tend to overestimate correct handling. Thus, physicians must teach correct inhaler handling and assess inhaler technique frequently. This way, they have a major role in accomplishing optimal therapeutic effect, both in achieving initial correct technique and also in maintaining handling over time.

In the future, it would be interesting to design a multicentre study, including a higher amount of patients from multiple health institutions in Portugal in order to clarify some issues found in this study. Also, an observational study comparing asthma inhaler technique in the primary care and in the hospital setting would clarify if a difference in follow up exists between clinical situations. Finally, a longitudinal observation study where inhaler handling would be assessed initially and on a regular basis in order to observe technique over time, comparing the effect of receiving frequent inhaler training with no technique reinforcement, would give a picture of technique patterns over time.

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6. Appendix

6.1. Appendix I - Informed Consent

Eduardo Manuel Freitas Ferreira, da Faculdade Ciências da Saúde da Universidade da Beira Interior, a realizar um trabalho de investigação subordinado ao tema "Caracterização de Doentes Idosos e Não Idosos com Asma Brônquica: Perspetiva do Uso de Inaladores", vem solicitar a sua colaboração neste estudo.

Informo que a sua participação é voluntária, podendo desistir a qualquer momento sem que por isso venha a ser prejudicado nos cuidados de saúde prestados pelo CHCB, EPE; informo ainda que a sua privacidade será respeitada, todos os dados recolhidos serão confidenciais e não serão fornecidas quaisquer compensações.

Objetivo do trabalho de investigação: Com este estudo pretende-se: 1) Comparar as taxas e tipos de erros da técnica inalatória em asmáticos idosos e não-idosos; 2) Comparar a auto-perceção do domínio da técnica inalatória com a capacidade real de execução em asmáticos idosos e não-idosos e 3) Avaliar fatores influenciadores da técnica inalatória em asmáticos idosos e não-idosos.

Critérios de inclusão: Doentes idosos (< 65 anos) e não-idosos (18-65 anos), clinicamente diagnosticados com asma brônquica e seguidos nos serviços de imuno-alergologia e Pneumologia do CHCB.

Critérios de exclusão: Doentes com outras doenças alérgicas ou cardio-pulmonares que possam interferir com o diagnóstico clínico, assim como doentes que apresentem deteorização cognitiva.

Procedimentos necessários: 1) Questionário estandardizado acerca do conhecimento sobre a técnica inalatória e 2) Avaliação emocional e cognitiva, utilizando: a) Escala de Depressão Geriátrica (GDS); b) Escala de Depressão em não-idosos (CES-D) e c) Mini mental state examination (MMSE).

Risco/ Benefício da sua participação: Este estudo poderá ajudar a caracterizar melhor os principais erros ou dificuldades que os doentes asmáticos sentem ao manusear os seus inaladores assim como a relação entre a sua auto-perceção do domínio da técnica e a capacidade real de execução. Permitirá identificar os principais erros cometidos que influenciam o controlo clinico da doença e tirar ilações sobre intervenções que possam ser aplicadas na prática clinica de modo a conseguir reduzir a taxa de erros e aumentar o controlo clinico. Contribuirá para uma melhoria da qualidade de vida dos mesmos, traduzida por um diagnóstico atempado, correto e com a respetiva adequação do tratamento aos mais vários níveis da prevenção. Todos os procedimentos supracitados serão efetuados pelos investigadores, com experiência na aplicação das mesmas.

Duração da participação no estudo: Março 2015 – Março 2016

Nº aproximado de participantes: 100 voluntários idosos e 100 voluntários não-idosos com diagnóstico clinico de asma brônquica.

Contactos para esclarecimento de dúvidas: a26913@fcsaude.ubi.pt

<u>Consentimento Informado – Aluno / Investigador</u>

Ao assinar esta página está a confirmar o seguinte:

* Entregou esta informação;

* Explicou o propósito deste trabalho;

* Explicou e respondeu a todas as questões e dúvidas apresentadas pelo participante ou representante legal.

_____

Nome do Aluno / Investigador (Legível)

_____   ____ / ____ / ____

Assinatura do Aluno / Investigador   Data

<u>Consentimento Informado – Participante</u>

Ao assinar esta página está a confirmar o seguinte:

* O Sr. (a) leu e compreendeu todas as informações desta informação, e teve tempo para as ponderar;

* Todas as suas questões foram respondidas satisfatoriamente;

* Se não percebeu qualquer das palavras, solicitou ao aluno/investigador uma explicação, tendo este esclarecido todas as dúvidas;

* O Sr. (a) recebeu uma cópia desta informação, para a manter consigo.

_____   _____

Nome do Participante (Legível)   Representante Legal

_____   ____ / ____ / ____

(Assinatura do Participante ou Representante Legal)   Data

6.2. Appendix II – Sociodemographic Questionaire

<u>HISTÓRIA CLÍNICA</u>

<u>IDENTIFICAÇÃO/CARACTERIZAÇÃO DEMOGRÁFICA</u>

Nome:_____

Código de identificação:_____   Peso:_____(Kg)   Altura:_____(cm)

Sexo: F ___ M____

Idade: Data de nascimento:

Naturalidade:_____

Residência na **infância**: (rural (aldeia/vila/quinta)   (urbano)   Localidade:_____

Residência na **idade adulta/atual** : (rural (aldeia/vila/quinta)   (urbano) Localidade:_____

Características habitacionais:

Tem casa **alcatifada**?	Sim	Não
A sua casa tem **fungos/bolores** nas paredes/teto?	Sim	Não
Tem **animais**?	Sim: Onde? No quintal Dentro de casa Quais? Cão Gato Pássaros Outros, quais?_____	Não

Atividade laboral:

Reformado: Sim ____ Não: ____Qual atividade _____Tempo de exposição: _____anos

Profissões ao longo da vida:	Duração:	Mais recente
Indústria têxtil		
Minas		
Agricultura		
Outra, qual?		

Atividades extralaborais:	Duração
Caça	
Pesca	
Caminhadas	
Jardinagem	
Trabalho com lãs	
Arraiolos	
Outra, qual?	

Habilitações literárias/acadêmicas:
- ☐ Não estudou
- ☐ De 4 anos
- ☐ De 4 a 9 anos
- ☐ De 9 a 12 anos
- ☐ + de 12 anos

CLASSIFICAÇÃO SOCIAL INTERNACIONAL DE GRAFFAR

1. PROFISSÃO:

   1° Grau - Diretores de bancos, diretores técnicos de empresas, licenciados, engenheiros, profissionais com títulos universitários ou de escolas especiais e militares de alta patente.

   2° Grau - Chefes de secções administrativas ou de negócios de grandes empresas, subdirectores de bancos, peritos e técnicos.

   3° Grau - Adjuntos técnicos, desenhadores, caixeiros, contramestres, oficiais de primeira, encarregados, capatazes e mestres de obras.

   4° Grau - Motoristas, policias, cozinheiros, dactilógrafas, etc

   5° Grau - Jornaleiros, porteiros, contínuos, ajudantes de cozinha, mulheres de limpeza, etc ....

2. INSTRUÇÃO:

   1 ° Grau -Ensino Universitário ou equivalente;

   2° Grau -Ensino médio ou técnico superior;

   3° Grau -Ensino médio ou técnico inferior;

   4° Grau -Ensino Primário completo;

   5° Grau -Ensino primário incompleto.

3. PRINCIPAL FONTE DE R ENDIMENTOS FAMILIARES

Qual é a principal fonte de rendimentos?

Fortuna herdada ou adquirida (Ex: Propriedades)☐

Altos vencimentos ou honorários (Ex: Lucros de empresas)☐

Vencimento mensal fixo (Ex: Funcionários)☐

Remuneração incerta (Ex: Remuneração semanal ou de horas de serviço)☐

Assistencial (Ex: Beneficência pública ou privada)☐

Outra. Qual ? _____

4. TIPO DE HABITAÇÃO

De que tipo é a sua habitação?

Casa ou andar luxuoso e muito grande, oferecendo o máximo de conforto ☐

Casa ou andar que, sem ser luxuoso, é espaçoso e confortável ☐

Casa ou andar modesto, bem construído, bem conservado, bem iluminado e arejado, com cozinha e casa de banho ☐

Casa ou andar degradado, sem electrodomésticos mas com cozinha e casa de Banho ☐

Alojamento impróprio, andar ou barraca desprovido de conforto, ventilação e iluminação, ou onde moram demasiadas pessoas☐

Outro. Qual ? _____

5. LOCAL DA RESIDÊNCIA

Qual é o aspecto da zona onde habita ?

Bairro residencial elegante, onde o valor do terreno ou os alugueres são elevados (Ex: Bairro elegante) ☐

Bairro residencial bom, de ruas largas com casas confortáveis e bem conservadas (Ex: Bom local)   ☐

Ruas comerciais ou estreitas e antigas com casas de aspecto geral menos confortável (Ex: Zonas antigas)   ☐

Bairro operário, populoso, mal arejado ou bairro em que o valor do terreno está diminuído como consequência da proximidade de fábricas (Ex: Bairro operário/social) ☐

Bairro "de lata" ☐

Outro. Qual ? _____

CLASSIFICAÇÃO SOCIAL

Aplicando coeficientes de ponderação de 1 a 5 em cada um dos grupos encontrados,

obteremos a seguinte classificação:

• Classe 1 – Famílias cuja soma de pontos vai de 5 a 9

• Classe II – Famílias cuja soma de pontos vai de 10 a 13

• Classe III – Famílias cuja soma de pontos vai de 14 a 17

• Classe IV – Famílias cuja soma de pontos vai de 18 a21

• Classe V – Famílias cuja soma de pontos vai de 22 a 25

Antecedentes patológicos

		Não	Sim	Idade	Qual	Caraterização
Infância	Doença respiratória					
	História de alergias					
Idade adulta	Doença respiratória					
	História de alergias					
	Rinite alérgica:					No último ano/nºvezes
	Dermatite atópica:					No último ano/nºvezes
	Outras: ✓ Depressão ✓ Demência ✓ Doenças gástricas:____ ✓ DMtipo_____ ✓ HTA ✓ EAM ✓ ICC ✓ Antecedentes de cirurgia cardiotorácica					

Antecedentes familiares

		Não	Sim	Idade	Qual	Caraterísticas
Doença respiratória	Pai					
	Mãe					
	Irmãos					
História de alergias	Pai					
	Mãe					
	Irmãos					

Hábitos medicamentosos

	Não	Sim, qual?	Dose	Posologia
BAAC (beta agonista ação curta):				
BAAL (beta agonista ação longa):				
IC (inalador corticoide):				
Modificador de Leucotrienos:				
Teofilina:				
CTO (Corticoterapia oral):				
Anti-IgE:				
Vacina anti gripe				
Vacina anti pneumocócica				
Anti-histamínicos				
Antidepressivos tricíclicos				

Beta bloqueadores				
AAS				

<u>Outros</u>:
  1. Antidepressivos
  2. Anti-hipertensores
  3. Anti-deslipidemicos
  4. Antidiabéticos orais
  5. Insulina
  6. IBP				

História de exposição

	EXPOSIÇÃO			PRECIPITANTE	
	Não	Sim	Duração	não	sim
Tabagismo **ativo**	**Nunca** fumou? **Deixou** de fumar? Há **quanto tempo deixou** de fumar?	**UMA** (anos de fumador*nºcigarros dia/20)=			
Tabagismo **passivo**					
Lareiras abertas					
Fogão a lenha					
Outros Fumos (qual)					
Aerossóis químicos (inseticidas, sprays desodorizantes, ambientadores…)					
Cheiros intensos (perfumes, lixivia, amoníaco, tintas, vernizes, diluentes)					
Tóxicos agrícolas					
Lãs					
Animais com **pêlo**					
Animais com **penas**					
Pó de casa					
Ácaros domésticos					
Pólens					
Fungos					
Infeções virais					
Exercício físico					
Frio/ Variações de temperatura/nevoeiro					
Emoções fortes					
Fármacos, como: − AAS − B-bloqueadores − Ibuprofeno					

6.3. Appendix III – Geriatric Depression Scale

IDOSOS - Escala de depressão geriátrica- GDS

	0	1
1 – Satisfeito com a sua vida?	S	N
2 – Teve de abandonar muitas das suas actividades?	N	S
3 – Acha que a sua vida é vazia?	N	S
4 – Aborrece-se muitas vezes?	N	S
5 – Está alegre a maior parte das vezes?	S	N
6 – Tem medo de que lhe aconteça algo de mau?	N	S
7 – Sente-se feliz a maior parte do tempo?	S	N
8 – Sente-se frequentemente sem auxílio?	N	S
9 – Prefere ficar em casa a sair para a rua e fazer coisas novas?	N	S
10 – Acha que tem mais problemas de memória que os outros?	N	S
11 – Acha que é bom estar vivo?	S	N
12 – Acha que a sua vida, como está agora, já não tem valor?	S	N
13 – Acha-se cheio de energia?	S	N
14 – Acha que a sua situação não tem remédio?	S	N
15 – Acha que a maior parte das pessoas está melhor que você?	N	S
TOTAL		

Chave:

Normal	0-5	
Ligeiramente deprimido, em progressão	6-10	
Gravemente deprimido	11-15	

6.4. Appendix IV – Centre for Epidemiological Studies Depression Scale

NÃO IDOSOS – ESCALA DE DEPRESSÃO (CES-D)

Nº....................

CES-D

Encontra nesta página uma lista das maneiras como se pode ter sentido ou reagido. Indique com que frequência se sentiu dessa maneira **durante a semana passada** fazendo uma cruz no quadrado correspondente.

Use a seguinte chave:
- ☐ Nunca ou muito raramente (menos de 1 dia)
- ☐ Ocasionalmente (1 ou 2 dias)
- ☐ Com alguma frequência (3 ou 4 dias)
- ☐ Com muita frequência ou sempre (5 ou 7 dias)

Durante a semana passada:	Nunca ou muito raramente	Ocasional-mente	Com alguma frequência	Com muita frequência ou sempre
1. Fiquei aborrecido com coisas que habitualmente não me aborrecem	☐	☐	☐	☐
2. Não me apeteceu comer; estava sem apetite	☐	☐	☐	☐
3. Senti que não conseguia livrar-me da neura ou da tristeza, mesmo com a ajuda da família ou dos amigos	☐	☐	☐	☐
4. Senti que valia tanto como os outros	☐	☐	☐	☐
5. Tive dificuldade em manter-me concentrado no que estava a fazer	☐	☐	☐	☐
6. Senti-me deprimido	☐	☐	☐	☐
7. Senti que tudo o que fazia era um esforço	☐	☐	☐	☐
8. Senti-me confiante no futuro	☐	☐	☐	☐
9. Pensei que a minha vida tinha sido um fracasso	☐	☐	☐	☐
10. Senti-me com medo	☐	☐	☐	☐
11. Dormi mal	☐	☐	☐	☐
12. Senti-me feliz	☐	☐	☐	☐
13. Falei menos do que o costume	☐	☐	☐	☐
14. Senti-me sozinho	☐	☐	☐	☐
15. As pessoas foram desagradáveis ou pouco amigáveis comigo	☐	☐	☐	☐
16. Senti prazer ou gosto na vida	☐	☐	☐	☐
17. Tive ataques de choro	☐	☐	☐	☐
18. Senti-me triste	☐	☐	☐	☐
19. Senti que as pessoas não gostavam de mim	☐	☐	☐	☐
20. Senti falta de energia	☐	☐	☐	☐

T Fagulha & B Gonçalves. FPCE-UL. Versão para estudo. Circulação restrita

6.5. Appendix V – Mini-Mental State Examination Questionaire

Mini Mental State Examination (MMSE)

1. Orientação (1 ponto por cada resposta correcta)
Em que ano estamos? _____
Em que mês estamos? _____
Em que dia do mês estamos? _____
Em que dia da semana estamos? _____
Em que estação do ano estamos? _____

Nota:____

Em que país estamos? _____
Em que distrito vive? _____
Em que terra vive? _____
Em que casa estamos? _____
Em que andar estamos? _____

Nota:____

2. Retenção (contar 1 ponto por cada palavra correctamente repetida)

"Vou dizer três palavras; queria que as repetisse, mas só depois de eu as dizer todas;
procure ficar a sabê-las de cor".
Pêra _____
Gato _____
Bola _____

Nota:____

3. Atenção e Cálculo (1 ponto por cada resposta correcta. Se der uma errada mas depois
continuar a subtrair bem, consideram-se as seguintes como correctas. Parar ao fim de 5
respostas)

"Agora peco-lhe que me diga quantos são 30 menos 3 e depois ao número encontrado volta
a tirar 3 e repete assim até eu lhe dizer para parar".
27_ 24_ 21 _ 18_ 15_

Nota:____

4. Evocação (1 ponto por cada resposta correcta.)

"Veja se consegue dizer as três palavras que pedi há pouco para decorar".
Pêra _____
Gato _____
Bola _____

Nota:____

5. Linguagem (1 ponto por cada resposta correcta)

a. "Como se chama isto? Mostrar os objectos:
Relógio ____
Lápis_____

Nota:____

b. "Repita a frase que eu vou dizer: O RATO ROEU A ROLHA"

Nota:____

c. "Quando eu lhe der esta folha de papel, pegue nela com a mão direita, dobre-a ao meio e
ponha sobre a mesa"; dar a folha segurando com as duas mãos.
Pega com a mão direita____
Dobra ao meio ____
Coloca onde deve____

Nota:_____

d. "Leia o que está neste cartão e faça o que lá diz". Mostrar um cartão com a frase bem legível, "FECHE OS OLHOS"; sendo analfabeto lê-se a frase.
Fechou os olhos_____

Nota:_____

e. "Escreva uma frase inteira aqui". Deve ter sujeito e verbo e fazer sentido; os erros gramaticais não prejudicam a pontuação.
Frase:

Nota:_____

. Habilidade Construtiva (1 ponto pela cópia correcta.)
Deve copiar um desenho. Dois pentágonos parcialmente sobrepostos; cada um deve ficar com 5 lados, dois dos quais intersectados. Não valorizar tremor ou rotação.
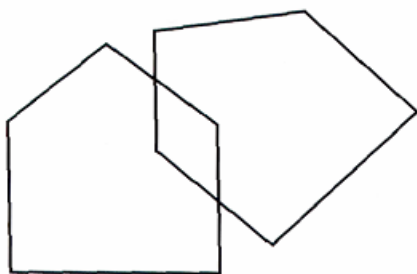
Cópia:

Nota:_____

TOTAL(Máximo 30 pontos):_____

Considera-se com defeito cognitivo: • analfabetos ≤ 15 pontos
• 1 a 11 anos de escolaridade ≤ 22
• com escolaridade superior a 11 anos ≤ 27

6.6. Appendix VI – Inhaler Technique Questionnaire

Avaliação da utilização de inaladores de asma brônquica por doentes idosos
Medicação inalada que toma para a asma brônquica

Fármaco	Dosagem	Tipo de Inalador	Data de início	Frequência (contínuo/SOS)

Tipo de Inalador- <u>chave:</u> **MDI-inalador pressurizado**; **DPI** (TURBOHALER; DISKUS; AEROLIZER; NOVOLIZER; INALADOR FARMOZ; TWISTHALER; BREEZEHALER; SPIROMAX)

1) Qual é o inalador que usa na crise de asma?
   a. BAAC (Ventilan, Salbutamol Novolizer, Bricanyl)
   b. BAAL (Formoterol, Salmeterol)
   c. Corticoide inalado
   d. Nenhum

2) Qual é o inalador que usa para o tratamento contínuo/prevenção das crises de asma?
   a. BAAC (Ventilan, Salbutamol Novolizer, Bricanyl)
   b. BAAL (Formoterol, Salmeterol)
   c. Corticoide inalado
   d. Nenhum

3) Qual acha que é o grau de dificuldade no manuseamento dos dispositivos inaladores?
   a. Fácil
   b. Moderada
   c. Difícil
   d. Não sabe

4) Acha que a técnica inalatória que utiliza é correcta?
   a. Sim
   b. Não
   c. Não sabe

5) Teve formação na técnica inalatória?
   a. Sim
   b. Não

6) Se sim, por parte de quem?
   a. Médico assistente
   b. Enfermeiro
   c. Farmacêutico
   d. Familiar

7) Alguém verificou a sua técnica inalatória?

    a.   Sim

    b.   Não

8) A técnica inalatória é verificada com regularidade?

    a.   Sim

    b.   Não

9) Se sim, como é feita a verificação?

    a.   Técnica demonstrada pelo profissional de saúde.

    b.   Solicitando a exemplificação da técnica ao doente.
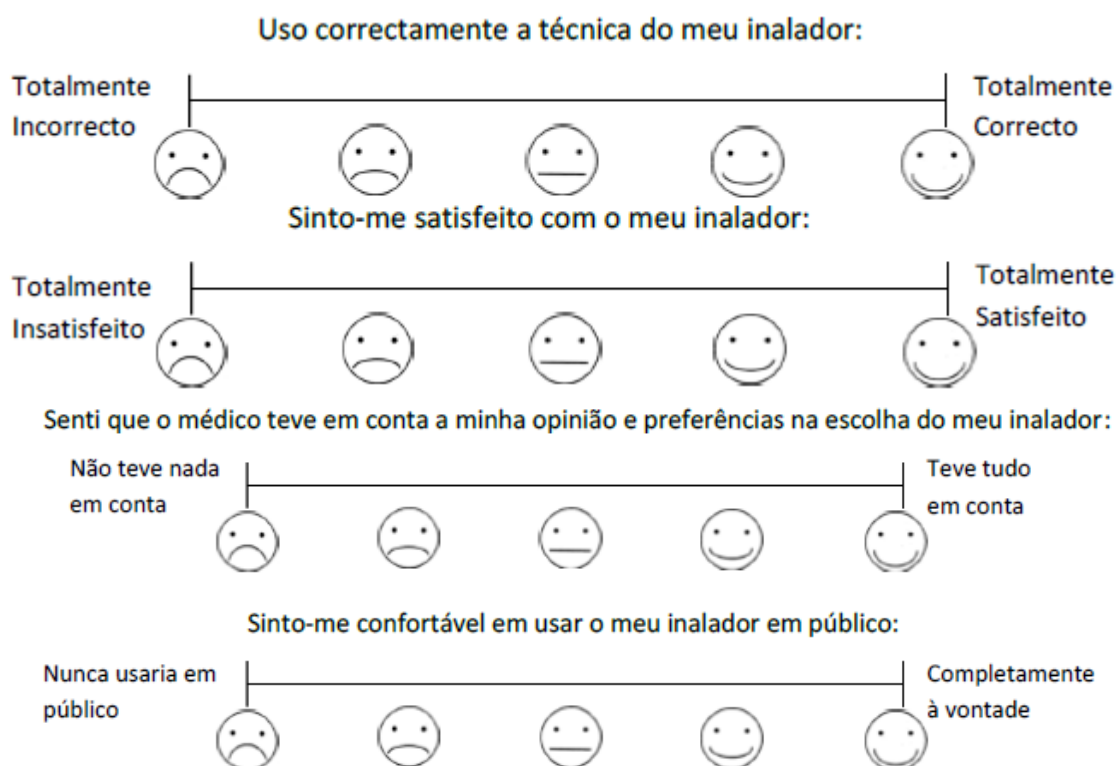
Observação directa da técnica inalatória

  a) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável

Erros *major*

  1- **Preparação inadequada,** inclui:

    a. **Dispositivo em más condições** (vazio, fora do prazo de validade, etc);

    b. **Falha ao retirar a tampa**

    c. **Falha em agitar inalador**

    d. **Falha ao carregar dispositivo DPI ou iniciar MDI**

  2- **Falha ao colocar inalador na posição correcta**

  3- **Falha em acionar o dispositivo MDI em simultâneo com a inspiração- antes/depois**

  4- **Falha a inalar através do dispositivo**

  5- **Técnica inspiratória inadequada**

  6- **Falha em suster a respiração após inalação (10 seg.)**

Erros *minor*

  6- **Falha na expiração adequada**

  7- **Falha na inclinação da cabeça para trás**

  9- **Falha a expirar lentamente, com os lábios semi-cerrados**

Técnica inalatória **MDI- inalador pressurizado**

Agita o inalador[a]	Sim Não
Retira a tampa[a]	Sim Não
Deita o ar fora[b]	Sim Não
Inclina a cabeça um pouco para trás[b]	Sim Não
Coloca bocal do inalador correctamente na boca, com o contentor voltado para cima e com os lábios cerrados em torno do bucal [a]	Sim Não
Carrega no botão do inalador e ao mesmo tempo, começa a inspirar [a]	Sim Não
Faz inspiração lenta e forte [a]	Sim Não
Retira inalador da boca	Sim Não
Mantém o peito cheio de ar durante 10 segundos [b]	Sim Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim Não
Coloca a tampa no inalador	Sim Não

[a]Erro *major*; [b]Erro *minor*

   a) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

Técnica inalatória **TURBOHALER-TH**

Retira a tampa do TH[a]	Sim Não
Roda a base do TH para a direita[a]	Sim Não
Roda a base do TH para a esquerda até se ouvir um estalido[a]	Sim Não
Deita o ar fora[b]	Sim Não
Inclina a cabeça um pouco para trás[b]	Sim Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bocal	Sim Não
Faz inspiração rápida e forte[a]	Sim Não
Retira bocal da boca	Sim Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim Não
Coloca a tampa no inalador	Sim Não

[a]Erro *major*; [b]Erro *minor*
   a) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

Técnica inalatória **DISKUS-DK**

Empurra goteira do DK para trás[a]	Sim Não
Empurra patilha do DK toda para trás[a]	Sim Não
Deita o ar fora[b]	Sim Não
Inclina a cabeça um pouco para trás[b]	Sim Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim Não
Faz inspiração rápida e forte[a]	Sim Não
Retira bocal da boca	Sim Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim Não
Empurra goteira do DK para a esquerda	Sim Não

[a]Erro *major*; [b]Erro *minor*
   a) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

Técnica inalatória **AEROLIZER-ARL**

Retira a tampa do ARL[a]	Sim Não
Roda a parte de cima para a esquerda, para abrir ARL[a]	Sim Não
Coloca cápsula na ranhura do ARL[a]	Sim Não
Roda a parte de cima do ARL para o fechar[a]	Sim Não
Carrega nos botões laterais para furar a cápsula[a]	Sim Não
Deita o ar fora[b]	Sim Não
Inclina a cabeça um pouco para trás[b]	Sim Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim Não
Faz inspiração rápida e forte[a]	Sim Não
Retira bocal da boca	Sim Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim

	Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim
	Não
Abre parte de cima do ARL e deita fora a cápsula	Sim
	Não
Fecha a parte de cima e re-coloca a tampa no inalador	Sim
	Não

[a]Erro *major*; [b]Erro *minor*
 a) Técnica correcta b) Técnica aceitável c) Técnica não aceitável/incorrecta

Técnica inalatória **NOVOLIZER-NVL**

Retira a tampa do NVL[a]	Sim
	Não
Carrega no botão da parte de trás do NVL até ouvir um estalido[a]	Sim
	Não
Deita o ar fora[b]	Sim
	Não
Inclina a cabeça um pouco para trás[b]	Sim
	Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim
	Não
Faz inspiração rápida e forte[a]	Sim
	Não
Retira bocal da boca	Sim
	Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim
	Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim
	Não
Coloca a tampa no inalador	Sim
	Não

[a]Erro *major*; [b]Erro *minor*
 a) Técnica correcta b) Técnica aceitável c) Técnica não aceitável/incorrecta

Técnica inalatória **INALADOR FARMOZ-IBF**

Coloca IBF com parte castanha para cima[a]	Sim
	Não
Roda a parte de cima para a esquerda até sair a tampa de baixo[a]	Sim
	Não
Carrega na parte de cima do IBF, até sair a tampa de baixo[a]	Sim
	Não
Deita o ar fora[b]	Sim
	Não
Inclina a cabeça um pouco para trás[b]	Sim
	Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim
	Não
Faz inspiração rápida e forte[a]	Sim
	Não

Retira bocal da boca	Sim Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim Não
Coloca a tampa no inalador	Sim Não

[a]Erro *major*; [b]Erro *minor*
    a) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

Técnica inalatória **BREEZHALER-BZL**

Retira a tampa do BZL[a]	Sim Não
Segura firmemente a base do inalador e levanta o bocal do BZL[a]	Sim Não
Coloca a cápsula na câmara da cápsula[a]	Sim Não
Fecha o inalador até ouvir um clique[a]	Sim Não
Carrega nos botões laterais para furar a cápsula[a]	Sim Não
Deita o ar fora[b]	Sim Não
Inclina a cabeça um pouco para trás[b]	Sim Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim Não
Faz inspiração rápida e forte[a]	Sim Não
Retira bocal da boca	Sim Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim Não
Abre parte de cima do BZL e deita fora a cápsula	Sim Não
Fecha a parte de cima e re-coloca a tampa no inalador	Sim Não

[a]Erro *major*; [b]Erro *minor*
    b) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

Técnica inalatória **SPIROMAX-SPM**

Abre a tampa do bucal dobrando-a para baixo até ouvir um clique[a]	Sim Não
Deita o ar fora[b]	Sim Não

Inclina a cabeça um pouco para trás[b]	Sim / Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim / Não
Faz inspiração rápida e forte[a]	Sim / Não
Retira bocal da boca	Sim / Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim / Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim / Não
Fecha a cobertura do aplicador bucal	Sim / Não

[a]Erro *major*; [b]Erro *minor*

   b) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

Técnica inalatória **TWISTHALER-TWL**

Retira a tampa do TWL[a]	Sim / Não
Deita o ar fora[b]	Sim / Não
Inclina a cabeça um pouco para trás[b]	Sim / Não
Coloca bocal do inalador correctamente na boca, com os lábios cerrados em torno do bucal	Sim / Não
Faz inspiração rápida e forte[a]	Sim / Não
Retira bocal da boca	Sim / Não
Mantém o peito cheio de ar durante 10 segundos[b]	Sim / Não
Expira lentamente, com os lábios semi-cerrados[b]	Sim / Não
Coloca a tampa no inalador	Sim / Não

[a]Erro *major*; [b]Erro *minor*

   c) Técnica correcta   b) Técnica aceitável   c) Técnica não aceitável/incorrecta

6.7. Appendix VII – STROBE Statement

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page Nº
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	ix
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	ix
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	3
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4*
Bias	9	Describe any efforts to address potential sources of bias	3
Study size	10	Explain how the study size was arrived at	3
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	5
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-9
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence	10-11

		interval). Make clear which confounders were adjusted for and why they were included	
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18-19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.