

Malnutrition and Adapted Physical Activity in Older Adults: Impact of a Brief Training Program on General Practitioners' Knowledge and Practices: A Randomized Controlled Trial

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Additional Declarations: No competing interests reported.

Abstract

Background

Life expectancy continues to increase in France, along with the number of older adults at risk of frailty and loss of independence. Promoting adapted physical activity (APA) and managing malnutrition are major public health priorities. General practitioners (GPs) play a central role in prevention, yet insufficient training remains a major barrier. This study aimed to assess the impact of a brief training intervention on GPs' knowledge and practices in these two areas.

Methods

This randomized study included final-year GP residents and practicing GPs in the Pays de la Loire region (France) in 2025. Participants were randomly assigned to either an APA training group or a malnutrition training group. Knowledge and self-reported practices were assessed using an online questionnaire before and one month after the intervention. The training consisted of a 15-minute video and a summary leaflet. Linear mixed models were used to analyze the time $\times$ group interaction.

Results

Thirty GPs completed the study (16 malnutrition group; 14 APA group). APA training was associated with a significant increase in APA prescriptions compared with the malnutrition group ($p = 0.03$), as well as improved knowledge of local APA structures ($p = 0.02$). Malnutrition training did not significantly affect oral nutritional supplement prescriptions but significantly increased dietary enrichment prescriptions compared with the APA group ($p = 0.02$).

Conclusions

A brief, targeted training intervention on APA or malnutrition significantly improved GPs' knowledge and positively influenced selected prescribing practices. Integrating such training into continuing medical education may have meaningful public health implications.

TRIAL REGISTRATION

This trial was registered retrospectively on ClinicalTrials.gov on August 2026 (Registration ID: NCT07794657)

BACKGROUND

Population aging in France is accompanied by a growing number of frail older adults ¹. Frailty is a common and potentially reversible clinical syndrome in primary care and a precursor to dependency ²⁻⁴. It is associated with increased risks of falls, hospitalization, institutionalization, and mortality ². According to the Fried model, reduced physical activity (PA) and weight loss are major determinants of frailty ³.

Regular PA helps prevent frailty and mitigate its consequences in older adults. Even low-intensity activity improves mobility, balance, muscle strength, and functional status ⁵. Since 2017, French general practitioners (GPs) have been authorized to prescribe adapted physical activity (APA) as a non-pharmacological treatment ⁶. Despite dedicated initiatives such as local “sport houses for health”, APA remains underutilized in routine primary care ^{7,8}.

Malnutrition is another frequent geriatric syndrome, affecting approximately 15 to 30% of community-dwelling older adults ⁹. It is associated with increased morbidity, mortality, and impaired quality of life. Although screening relies on simple clinical criteria, malnutrition remains underdiagnosed in primary care ¹⁰. Management too often relies exclusively on oral nutritional supplements (ONS), with insufficient emphasis on practical dietary advice and food enrichment strategies ¹¹.

GPs therefore play a pivotal role in preventing, detecting, and managing frailty, sedentary behavior, and malnutrition ^{12,13}. However, several studies report persistent barriers to prescribing non-pharmacological interventions, notably insufficient training and limited awareness of local resources ¹⁴.

In this context, we developed two brief training modules for GPs in the Pays de la Loire region: one focused on malnutrition and the other on APA. These were based on the hypothesis that a short video combined with a summary leaflet could address these gaps. The objective was to evaluate the impact of each training module on GPs’ knowledge and professional practices.

METHODS

Study design

This was a randomized, parallel-group interventional study conducted in 2025 in the Pays de la Loire region (France). Each group served as an active control for the topic not received. This study adhered to CONSORT guidelines (see supplementary material for CONSORT checklist).

Participants

Eligible participants were final-year GP residents (in ambulatory training) and practicing GPs in the region. Recruitment occurred in two phases: invitations to residents (November 2024, reminder May 2025) and regional dissemination via the Regional Union of Private Practitioners (April 2025). Inclusion took place between January 13 and August 14, 2025.

Intervention

Participants were randomized equally (1:1 allocation ratio), using a computer-generated random allocation sequence, to:

- Malnutrition group: 10-minute online training video plus summary leaflet.
- APA group: 14-minute online training video plus summary leaflet.

The malnutrition video was designed by JB. It was based on local and international guidelines^{15,16}. It covered definition, diagnostic criteria, causes, consequences, and management in primary care, with emphasis on dietary counseling and enrichment.

The APA video was designed by CL. It was based on local and world health organization (WHO) guidelines¹⁷. It reviewed frailty, PA recommendations, and practical guidance for prescribing APA, with emphasis on available online tools and local resources.

At the end of each video, participants were given a leaflet summarizing its main messages. Both leaflets are available in the supplementary material (SM) Figure S1 and S2. Content was validated by experts. Participants were informed they were evaluating a training program but were unaware of the control group (partial blinding). Identical questionnaires were administered at both time points.

Data collection

Knowledge and self-reported practices regarding APA and malnutrition were assessed using an online questionnaire before and one month after training. The questionnaire was designed to evaluate the average practice in the past month. It included:

- Practice characteristics
- Sedentary behavior and APA prescribing
- Malnutrition diagnosis and management

The questionnaire was designed so that participants could estimate the average number of relevant consultations and prescriptions over the previous month. The full questionnaire is available in Table S1 of SM.

Outcomes

Primary objectives were:

- to evaluate the impact of APA training on APA prescriptions.
- to evaluate the impact of malnutrition training on malnutrition management.

Each group served as control group for the other. Our primary outcome was the change in the number of topic-related prescriptions in the previous month. For malnutrition, dietary enrichment and ONS prescriptions were analyzed separately.

Secondary outcomes included changes in diagnostic practices and knowledge.

Sample size

Due to the exploratory nature of this study, no formal sample size calculation was performed prior to recruitment. We aimed to include a pragmatic sample of eligible general practice residents and practicing GPs in the region during the study period.

Statistical analysis

Only participants completing both questionnaires were analyzed. No imputation was performed. Descriptive statistics were expressed as number (percentage) or median (IQR). Linear mixed models assessed time × group interactions. Significance was set at 5%. No adjustment for multiple comparisons was performed due to exploratory analyses. All analyses were performed on R software (version 4.3).

Ethical considerations

The study complied with the Declaration of Helsinki and received approval from the Nantes University local ethics committee (URB00013074). Participation was voluntary and anonymous. Consent to participate was obtained from all of the participants in the study.

RESULTS

Participants' characteristics

Sixty-one GPs were initially recruited; 30 completed the study (14 APA; 16 malnutrition). Details are presented in the flow diagram (Figure 1). Baseline characteristics were comparable between groups (Table 1). Characteristics were also comparable between participants initially included (n=40) and analyzed (n=30); see Table S2 of SM. Participants included both residents and practicing GPs, predominantly working in group practices (77%) in urban or semi-rural areas. Mean daily consultations were approximately 20, with 5–6 involving renewal of prescriptions for older adults.

Primary outcomes

APA prescriptions

APA prescriptions increased significantly in the APA group compared with the malnutrition group ($p = 0.03$, Figure 2). The mean number increased from 1 to 3.5 prescriptions per month, with no increase in the control group.

Malnutrition management

Malnutrition training did not significantly affect ONS prescriptions ($p = 0.77$, Figure 3a). However, dietary enrichment prescriptions increased significantly in the malnutrition group (from 38% to 69% of malnutrition cases), whereas a decrease was observed in the APA group ($p = 0.02$, Figure 3b).

Secondary outcomes

APA

The number of consultations addressing APA showed a non-significant upward trend in the APA group ($p = 0.09$, Figure 4a). Knowledge of APA structures improved significantly in the APA group (86 vs 57%, $p = 0.01$, Figure 4b). The main barrier addressed was “lack of training,” rather than time or financial constraints. All of the outcomes are summarized in Table 2.

Malnutrition

No significant increase was observed in the number of consultations dedicated to malnutrition (Figure 5, $p = 0.28$). Some practices (meal fractionation, texture modification) increased modestly but not significantly. Referrals to dietitians remained stable. Dental referrals did not increase significantly (Table 2).

DISCUSSION

Sedentary behavior and malnutrition are major public health concerns^{18,19}. Given their central role in prevention, GPs occupy a strategic position in their management. This study demonstrates that a brief training intervention, combining a video and a summary leaflet designed for GPs, is associated with an increase in adapted physical activity (APA) prescriptions as well as dietary enrichment measures. In contrast, no significant impact was observed on the number of consultations addressing either physical activity or malnutrition. Furthermore, the study did not show an increase in ONS prescriptions, which were already high prior to the intervention.

Effects on prescribing

A 15-minute APA training significantly increased APA prescriptions. These findings align with international studies showing that targeted education enhances physical activity counseling and prescribing²⁰. Furthermore, a Canadian study showed that combining educational workshops with practical tools was an effective strategy to increase physical activity prescriptions; physicians in the intervention group reported higher self-efficacy and delivered advice more frequently to patients²¹. These results confirm that insufficient training remains one of the main barriers to APA prescription, highlighting the value of targeted educational interventions to strengthen physicians' skills and confidence in this area⁸.

Similarly, malnutrition training shifted practice toward dietary enrichment rather than exclusive reliance on ONS. Current guidelines emphasize combining nutritional support with physical activity and dietary strategies²². Participating GPs appeared to rely primarily on ONS prior to the intervention. Our intervention appears to have enhanced practical knowledge and broadened therapeutic approaches in line with recommendations¹⁵.

Secondary outcomes

Our study suggests an upward trend in the number of consultations during which APA was discussed. In a Canadian study among medical residents, those who had participated in theoretical training workshops addressed physical activity in a greater number of consultations²³. Similarly, a 2024 literature review reported that brief educational interventions for medical students improve both the frequency and quality of physical activity counseling provided to patients²⁴.

Knowledge of local APA resources also improved significantly, addressing a commonly reported barrier, both by practitioners and patients²⁵. These findings underscore the value of targeted educational interventions combining clinical training with information on local resources to enhance the effectiveness and relevance of counseling and prescriptions.

With respect to malnutrition, some diagnostic practices improved numerically but changes were modest and insignificant. Referral rates to other health professionals (dietitians, nutritionists) remained overall stable, confirming that information about malnutrition is often delivered by a single practitioner. Multidisciplinary management remains thus limited despite recommendations²⁶. In addition, dental care referrals did not increase significantly, despite evidence supporting their effectiveness²⁷.

Public health implications

Since 2017, French GPs have been authorized to prescribe APA for patients with long-term conditions⁶. However, APA education in medical school curricula remains largely optional, and no standardized mandatory national training currently exists. In our study, only three physicians reported having received formal training on this topic during medical school. Similarly, despite clear and consistent national and international recommendations for screening and managing malnutrition¹⁵, its implementation remains insufficient²⁸.

Similar findings have been reported internationally. In Canada, although 70% of medical students reported being aware of national physical activity recommendations, only 52% were able to cite them accurately²⁹. Furthermore, only 15% of Canadian residents considered their training in exercise prescription to be “adequate”³⁰. Comparable results are observed in the field of malnutrition, where healthcare professionals report lacking confidence in addressing malnutrition in routine practice³¹. Brief, scalable training programs may represent a pragmatic solution.

Effective implementation also requires time, accessible local resources and interprofessional collaboration. Initiatives such as advanced practice nurse-led programs (e.g., APN-FIT study ³²) illustrate complementary approaches to supporting GPs with other healthcare professionals. By promoting such prescriptions, it may be possible to reduce sedentary behavior and improve nutritional and functional status among older adults. This could help mitigate frailty. Ultimately, reducing frailty may translate into lower morbidity and mortality and have a substantial impact on public health.

Strengths and limitations

This study has several strengths. It included a broad range of GPs from the Pays de la Loire region, including locum physicians, established practitioners, and residents in ambulatory primary care training. The study population appears representative of frontline primary care providers involved in screening for malnutrition and promoting APA among older adults. Furthermore, the study employed a randomized design with partial blinding and dual comparison, strengthening internal validity.

However, several limitations should be acknowledged. First, physicians already sensitized to APA and malnutrition may have been more likely to participate. Second, the prospective design with two questionnaires one month apart led to a notable proportion of incomplete follow-up. Finally, the short duration of follow-up does not allow assessment of medium- or long-term retention of knowledge. Further studies are needed to evaluate long-term durability and direct clinical impact on patient outcomes.

CONCLUSIONS

A brief targeted training intervention on adapted physical activity and malnutrition improved GPs' knowledge and influenced selected prescribing practices. Given persistent training gaps, integrating such modules into continuing medical education may strengthen early detection and non-pharmacological management in older adults. At a broader level, these strategies may contribute to reducing frailty, morbidity, and mortality, with meaningful public health impact.

Abbreviations

GP: general practitioner

APA: adapted physical activity

PA: physical activity

ONS: oral nutritional supplements

WHO: world health organization

SM: supplementary material

Declarations

Ethics approval and consent to participate

The study complied with the Declaration of Helsinki and received approval from the Nantes University local ethics committee (URB00013074). Participation was voluntary and anonymous. Informed consent to participate was obtained from all of the participants.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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The authors did not receive support from any organization for the submitted work.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by JB, CL and JH. The first draft of the manuscript was written by JB and CL and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript

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Not applicable

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Tables

Table 1. Included participants' characteristics

	APA N = 14	Malnutrition N = 16
Position		
Resident	6 (43%)	9 (56%)
Practicing GP	8 (57%)	7 (44%)
Rural area	5 (36%)	2 (13%)
Urban area	7 (50%)	10 (63%)
Semi-rural area	5 (36%)	8 (50%)
Number of work days per month	12.5 (12.0, 15.0)	13.5 (12.0, 15.5)
Number of consultations per day	20.0 (18.0, 22.0)	20.0 (19.0, 23.0)
Number of geriatric consultations per day	7.0 (5.0, 13.0)	8.0 (7.0, 9.5)
Number of geriatric consultations with renewal of prescriptions per month	5.5 (4.0, 10.0)	6.0 (5.0, 7.0)

Number (%) or median (IQR)

APA: adapted physical activity; GP: general practitioner

Table 2. Changes by study arm and by questionnaire for the different variables assessed.

	APA arm (N=14)		Malnutrition arm (N=16)	
	M0	M1	M0	M1
APA variables				
Estimated number of consultations the past month	12 (10, 20)	27 (3, 50)	10 (3, 30)	3 (2, 8)
Knowledge of APA facilities	8 (57%)	12 (86%)	7 (44%)	6 (38%)
Written prescriptions in the past month	0.0 (0.0, 2.0)	2.0 (0.0, 3.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.5)
Prescription barriers				
<i>Lack of knowledge</i>	7 (50%)	5 (36%)	12 (75%)	10 (63%)
<i>Lack of time</i>	5 (36%)	7 (50%)	3 (19%)	5 (31%)
<i>Lack of facilities</i>	4 (29%)	4 (29%)	5 (31%)	6 (38%)
<i>Financial difficulties</i>	7 (50%)	9 (64%)	2 (13%)	3 (19%)
<i>Patient refusal</i>	0 (0%)	0 (0%)	3 (19%)	3 (19%)
Malnutrition variables				
Estimated number of consultations the past month	22 (1, 45)	24 (3, 50)	20 (11, 55)	15 (6, 35)
Number of consultations with weight analysis	26 (6, 70)	43 (18, 56)	39 (15, 75)	27 (10, 44)
Number of consultations with Albumin dosage	5 (2, 10)	5 (1, 8)	3 (0, 15)	3 (1, 10)
ONS prescription	12 (86%)	13 (93%)	12 (75%)	14 (88%)
Dietary enrichment	5 (36%)	3 (21%)	6 (38%)	11 (69%)
Nutritionist referral	1 (7.1%)	2 (14%)	2 (13%)	1 (6.3%)
Dietitian referral	3 (21%)	4 (29%)	3 (19%)	1 (6.3%)
Texture modification	0 (0%)	1 (7.1%)	1 (6.3%)	2 (13%)
Fractionation	0 (0%)	0 (0%)	1 (6.3%)	3 (19%)
Dentist referral	0 (0%)	0 (0%)	1 (6.3%)	2 (13%)

Number (%) or median (IQR)

The figures were assessed using two questionnaires administered at study inclusion (M0), before the initial training, and one month after the training (M1).

APA: adapted physical activity; ONS: oral nutritional supplements.

Figures

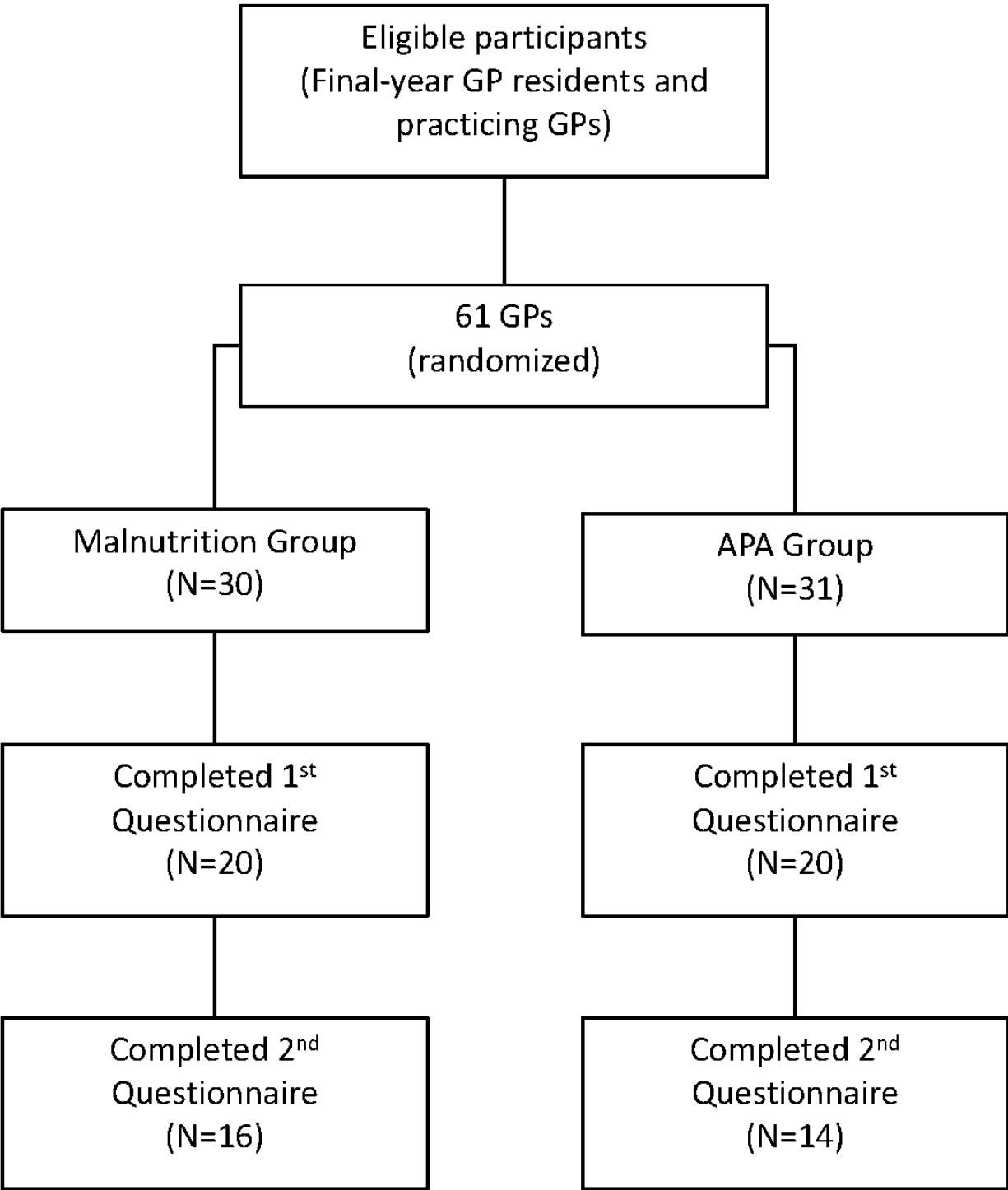


Figure 1

Flow diagram

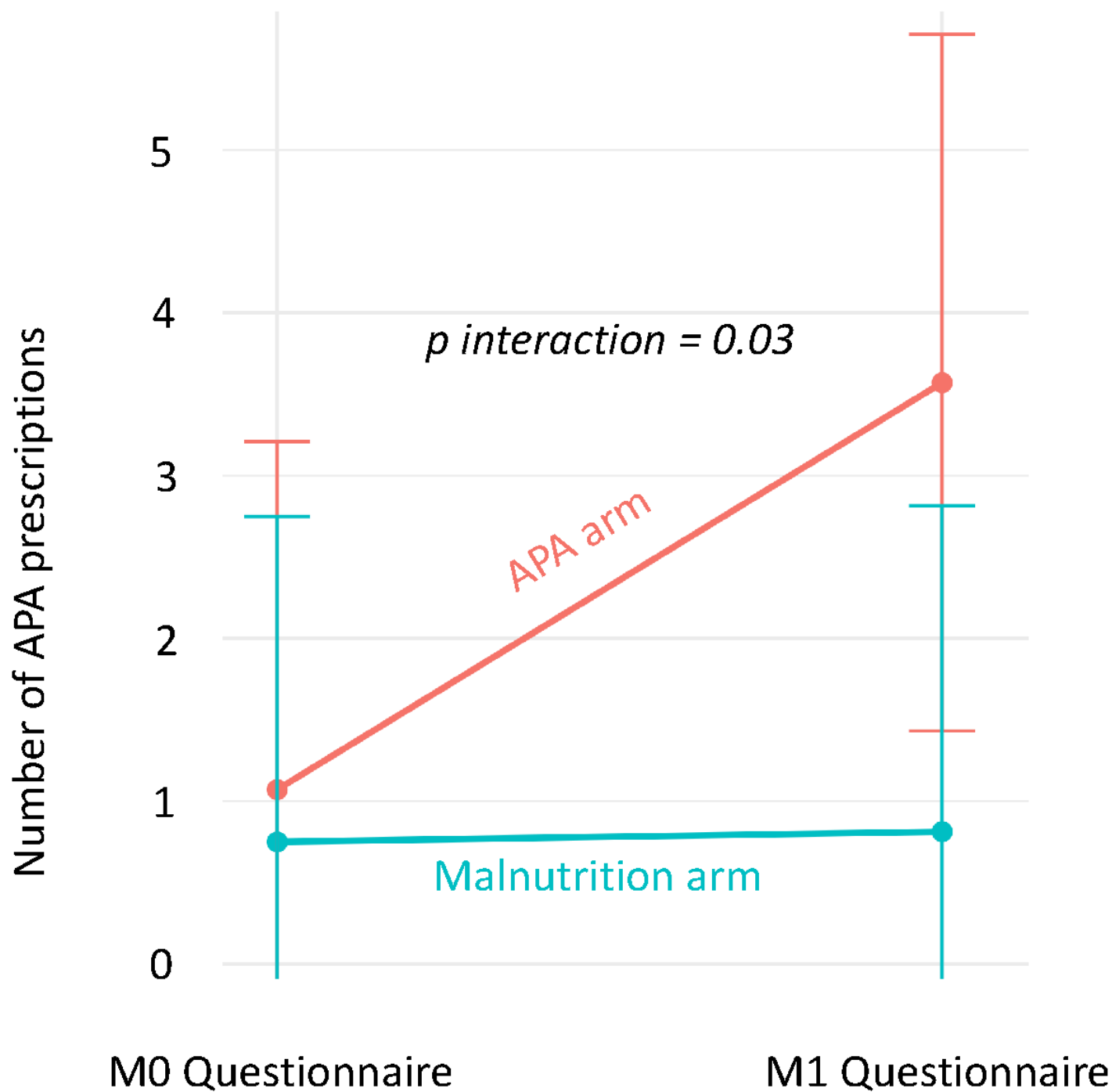


Figure 2

Change in the estimated number of adapted physical activity prescriptions over the previous month according to randomization group

The number of prescriptions was assessed using two questionnaires administered at study inclusion (M0), before the initial training. It was reassessed one month after the training (M1). The curves represent the change in mean values and standard deviations in each group (APA in red and Malnutrition in blue). The interaction p-value indicates the level of statistical significance of the group × time interaction in the linear mixed model.

APA: adapted physical activity.

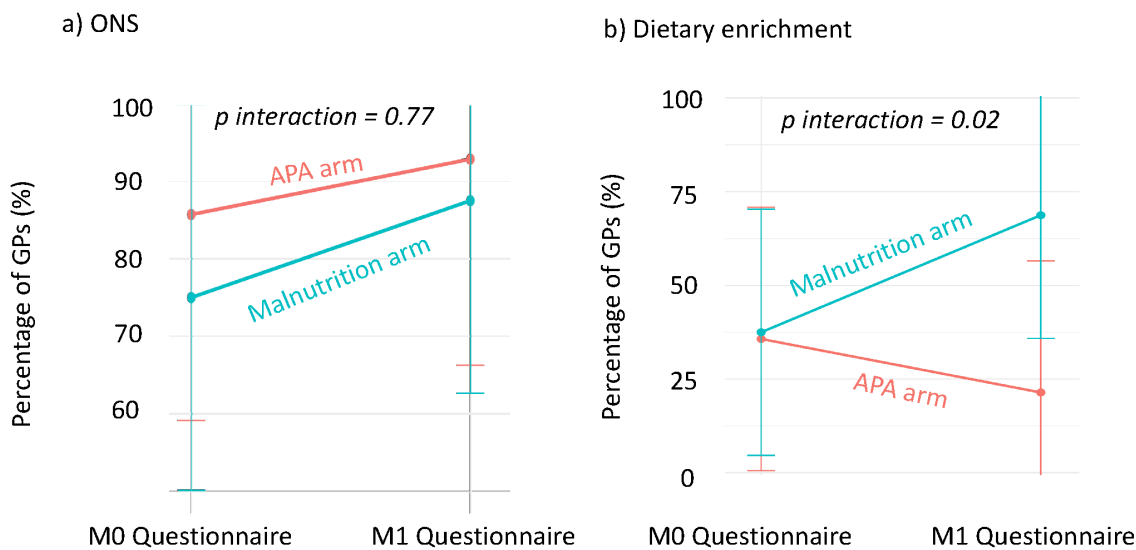


Figure 3

Change in the percentage of physicians reporting oral nutritional supplements and dietary enrichment as management options for malnutrition

a) Percentage of physicians reporting oral nutritional supplements (ONS)

b) Percentage of physicians reporting dietary enrichment

The curves represent the change in mean values and standard deviations in each group (APA in red and Malnutrition in blue). The interaction p-value indicates the level of statistical significance of the group × time interaction in the linear mixed model.

APA: adapted physical activity; ONS: oral nutritional supplements.

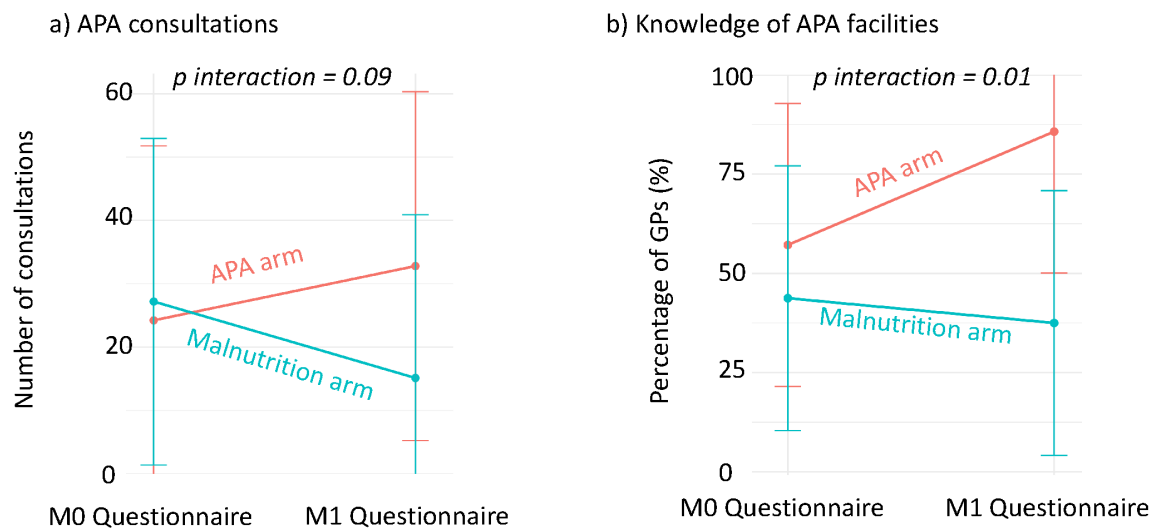


Figure 4

Change in the number of consultations and knowledge of APA facilities over the previous month

a) Change in the number of consultations addressing adapted physical activity (APA) over the previous month

b) Change in the percentage of participants reporting knowledge of facilities providing adapted physical activity over the previous month

The curves represent the change in mean values and standard deviations in each group (APA in red and Malnutrition in blue). The interaction p-value indicates the level of statistical significance of the group $\times$ time interaction in the linear mixed model.

APA: adapted physical activity.

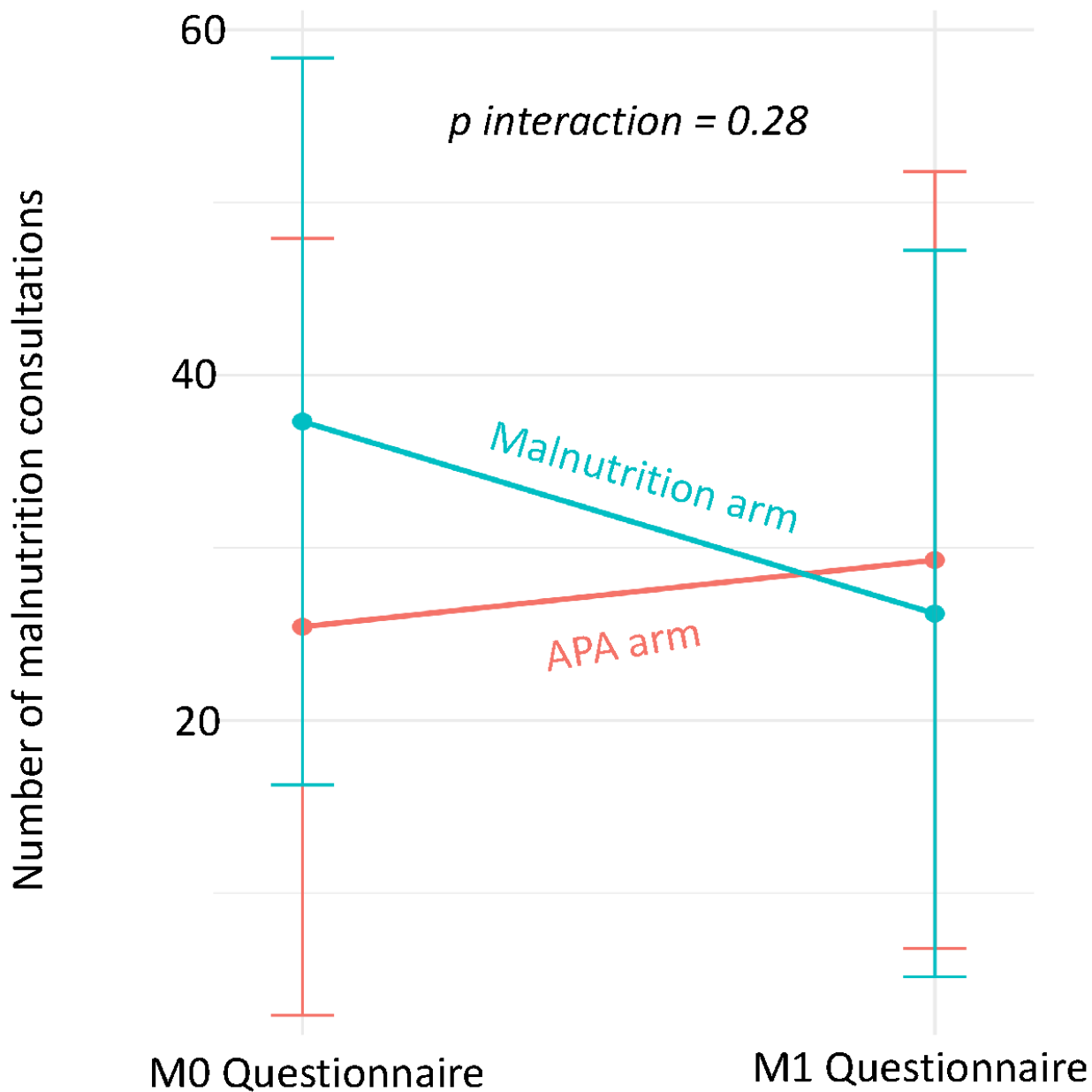


Figure 5

Change in the number of consultations dedicated to malnutrition

The curves represent the change in mean values and standard deviations in each group (APA in red and Malnutrition in blue). The interaction p-value indicates the level of statistical significance of the group $\times$ time interaction in the linear mixed model.

APA: adapted physical activity.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Supplementarymaterial.docx](#)