

## SYSTEMATIC REVIEW

# The Prevalence of Online Natural Health Products Purchase: A Systematic Review

Ju-Ying Ang<sup>1,2</sup>, Rhu-Yann Ho<sup>1</sup>, Seng-Fah Tong<sup>3</sup>, Fatimatuzzahra' Abd. Aziz<sup>1</sup>, Guat-See Ooi<sup>1</sup>

<sup>1</sup> School of Pharmaceutical Sciences, Universiti Sains Malaysia

<sup>2</sup> Clinical Research Centre (CRC), Hospital Raja Permaisuri Bainun, Ministry of Health, Malaysia

<sup>3</sup> Department of Family Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia

## ABSTRACT

**Aim and design:** This systematic review aimed to estimate the prevalence of online natural health products (NHPs) purchases among consumers. **Data Sources:** Four databases (PubMed, Science Direct, Scopus and Web of Sciences) were searched for articles published up to July 1, 2021. **Review Method:** Studies included were those reporting the prevalence of online NHPs purchases, those excluded were case reports, commentaries, letters, editorials, review articles, theses and non-English studies. The risk of bias of selected studies was assessed using the Joanna Briggs Institute's checklist, and the pooled prevalence of online NHPs purchases was generated using the random-effect model. **Results:** A total of 30 studies were included in the meta-analysis, representing a total of 40,535 respondents. The pooled prevalence of online NHPs purchases was estimated at 7.60% (95% CI: 5.49, 10.01). Prevalence was higher in studies conducted in recent years, among physically active populations and when sports nutrition was included within the scope of NHPs. More than half of the selected studies have a moderate risk of bias, and considerable heterogeneity was observed across the selected studies. **Conclusion and Impact:** Online purchases of NHPs are not common among consumers, but they have become more common in recent years. A wide range of NHPs were investigated across studies, which may have contributed to the considerable heterogeneity reported in this review. It is suggested that future studies investigating online NHPs purchases consider reporting individual prevalence statistics specific to each NHP type, to facilitate meaningful comparisons between studies.

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## Corresponding Author:

Guat-See Ooi, PhD

Email: guatsee.ooi@usm.my

Tel: +604-6534724

## INTRODUCTION

Natural health products (NHPs) are widely used to supplement one's diet and to enhance one's health functions, particularly in this era when people are becoming more involved in their health care (1). In the US, 57.6% of their adults use dietary supplements with an increase in supplement use observed across all age groups over the last decade (2-4). Notably, the NHPs industry is generating revenue and its global market is expected to expand in the approaching years (5). Such growth could be attributed to a rise in interest in natural substances, which were thought to be safer and have fewer side effects than medication (5,6).

Many NHPs are available without a prescription and are frequently self-selected by the general public. However, not all NHPs are evaluated for safety and efficacy before they are marketed; on the other hand, many of them

are regulated through post-market surveillance (7). In the other words, the consumers are responsible for their NHPs selection without much pre-market authorization undertaken by the regulators. On top of that, since NHPs contain biologically active substances, improper use of NHPs may also result in unwanted side effects or interactions with other medications (8,9).

With the advancement of information technology and the introduction of e-commerce, NHPs are no longer restricted to physical stores but is also freely accessible via the Internet. Moreover, the recent COVID-19 pandemic has further escalated the online sales of pharmaceutical and health-related products, resulting from the continuous movement restriction which compels consumers to shift from physical to online shopping (10). Besides, a higher perceived infection risk among consumers also propels them towards NHPs use (11). The prevalence of online NHPs purchases is thus expected to rise during this pandemic era.

Although NHPs use among consumers has been widely explored, the magnitude of online NHPs purchasing varies. Hence, this study aimed to review the prevalence

of online NHPs purchases among consumers.

## METHODOLOGY

This systematic review was registered with PROSPERO (ID: CRD42020222321) and the National Medical Research Register of Malaysia (NMRR-20-2250-56889 (IIR)). The reporting of study findings was in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (12).

### Search of literature

Published articles were searched via electronic databases, including PubMed, Science Direct, Scopus and Web of Sciences, from inception to November 2020, followed by an update search conducted on July 1, 2021. The document type was limited to 'Article' when searching on Science Direct and Web of Science. The search strategy combined keywords and terms related to online purchase (e.g., internet purchase, online shopping) and NHPs (e.g., dietary supplement, traditional and complementary medicine). Additionally, relevant studies were manually identified by screening through the reference lists of included articles.

### Eligibility criteria

In this review, NHPs may contain one or more of the following ingredients: probiotics, herbal remedies, vitamins and mineral, homeopathic medicines, traditional medicines and other products (e.g., amino acids and essential fatty acids) (13). Only orally administered NHPs were included in this study. On the other hand, this review defined 'online purchase' as the activity of obtaining NHPs over the Internet, regardless of the platform used or method of transaction that was involved. Since this review was to provide a general overview of online NHPs purchases across the board, studies involving any group of consumers were considered for review.

Included studies were those published in a peer-reviewed journal and those reporting the prevalence of online NHPs purchases or could be calculated from available data. Studies that combined sports nutrition (e.g., protein powder, sports drinks/bars) with NHPs were considered for further review as 'sports nutrition' was considered as a type of product that was intended to supplement an individual's diet. Studies excluded were case reports/series, commentaries, letters, editorials, review articles, theses, and studies that were published in languages other than English. Studies that combined over-the-counter medication, cosmetics or non-orally administered products with NHPs were also excluded from further review.

### Selection process

The titles and abstracts of records returned from the search were deduplicated. One review author assessed the study titles and abstracts, those that were irrelevant

to this review were removed. Subsequently, the full texts of the remaining studies were independently evaluated by two review authors. Any disagreements on the study eligibility were resolved by discussion, while a third review author was involved for arbitration if a disagreement remained unresolved.

### Data extraction

Data were extracted from selected studies using an Excel spreadsheet by a review author and later independently verified by second and third review authors to minimize bias and error. Information extracted were study details (author, year of study inception, country where the study was conducted, study design), respondents (sample size, demographics, number of NHPs users), types of product studied (whether sports nutrition was included as part of NHPs), study instrument used and the number of respondents reported online NHPs purchase. The count of respondents who purchased NHPs over the Internet was either acquired from the articles, calculated from available data, or extracted from presented graphs. The study sample size was taken as the denominator in the estimation of prevalence value. In order to resolve data-related uncertainties or missing information, the original authors were contacted via email to a maximum of three attempts.

### Risk of bias assessment

The quality of studies was independently assessed by two review authors using the critical appraisal tools from Joanna Briggs Institute (JBI) for prevalence studies (9 criteria) (14). For each study, the risk of bias was categorized based on the percentage of criteria met (indicated by a 'yes' response for a criterion): high risk ( $\leq 49\%$ ), moderate risk (50-69%) or low risk ( $\geq 70\%$ ) (15).

### Data analysis

In the meta-analysis, the prevalence of online NHPs purchases was pooled by employing the Freeman-Tukey transformation. Since diverse population groups and types of products were expected in this review, the random-effects model was used in meta-analysis. The 95% confidence interval (CI) was generated for each data of prevalence and no imputation was performed for missing data.

Heterogeneity across studies was evaluated using the  $I^2$  statistics ( $I^2 > 75\%$  suggesting considerable heterogeneity) and the chi-squared test, with a  $p$ -value  $< 0.1$  deemed significant (16). Subgroup analyses were performed to explore the possible sources of heterogeneity. The possibility of publication bias was assessed by visual inspection of the funnel plot as well as the Egger's test, with statistical significance considered when  $p < 0.05$ . To assess the stability of pooled prevalence, sensitivity analysis was performed by removing studies with a high risk of bias from the analysis. Statistical analyses were performed using the MedCalc® Statistical Software version 20.009 (MedCalc Software Ltd, Ostend, Belgium;

<https://www.medcalc.org>; 2021).

The quality of pooled prevalence was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework (17) by two reviewers independently in duplicate. Since the selected studies were observational in design, the quality of evidence started as 'low' and was modified downward based on the following criteria: (1) selected studies have important risk of bias, (2) inconsistency (considerable heterogeneity across studies), (3) indirectness (limited generalizability of findings), (4) imprecision (small number of events or wide 95% CI for pooled prevalence), (5) publication bias.

## RESULTS

### Search of literature

A total of 17,373 records were obtained from the literature search and the full-text articles of 287 studies were reviewed for eligibility. The studies removed (n=257) were reports (n=5), reviews (n=15), commentaries (n=1), those that were irrelevant to this review (n=219), published in languages other than English (n=6), not presenting usable data (n=1) or the surveyed product included medication, non-oral products or cosmetic (n=10). A final 30 studies were selected in this review (Fig. 1).

### Characteristics of selected studies

The 30 studies included in this review represented a total of 40,535 respondents, of which 9,438 NHPs users were identified in 27 studies, while this information was not reported in the other three studies (Table I). Half of these

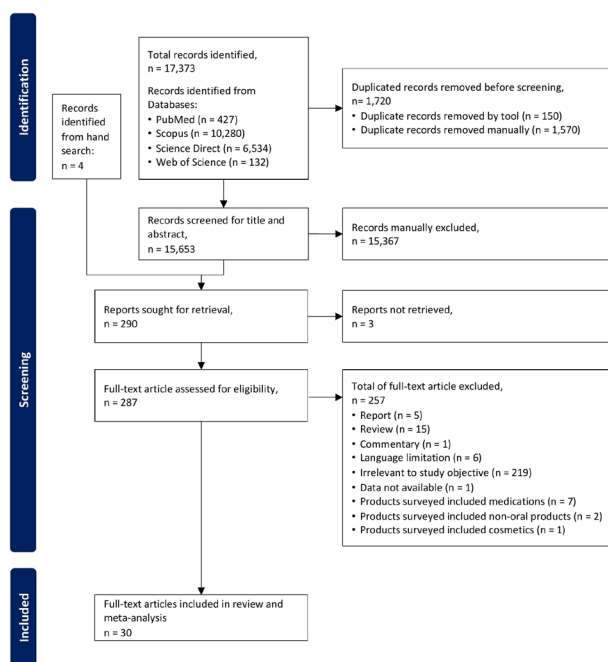


Figure 1: PRISMA flow diagram illustrating the flow of study selection in this review

studies recruited respondents from the Europe (n=16) (18-33), followed by Asia (n=6) (34-39), Middle East (n=3) (40-42), Northern America (n=3) (43-45), Oceania (n=1) (46) and one study involved respondents from 21 different nationalities (47). The majority of these studies (n=27) (18-30,32-42,44,46,47) were conducted within the last decade, except for three conducted between the late 1990s and before 2010 (31,43,45).

Ten studies reported online purchase of NHPs among patients (18-20,23,24,26,30,33,40,43), seven among the general public (21,32,34,35,42,44,46), while a few among athletes (n=4) (25,29,31,47), caregivers of children (n=3) (27,36,38), and two each among pregnant women (22,45), students (37,39) and fitness centre members (28,41). Online purchase of NHPs was collectively reported as any product sourced from the "Internet" or "online" in all studies, and one study included the purchase of the product by another person from abroad as part of the online purchase as well (38). Otherwise, none of these studies define the platform or process of online purchase in specific. Most studies covered a combination of products, including vitamins, minerals, probiotics, fish oil and/or herbal and traditional medicinal products, except seven studies that only focused on herbal and traditional medicinal products (e.g., honey and saiga horn) (18-20,23,24,34,35). Notably, six studies also included sports nutrition (e.g., protein powder, energy drinks/bars) as part of NHPs (25,28,29,31,41,47).

### Quality assessment of selected studies

Included studies were evaluated based on the JBI checklist for prevalence, four of them had a low risk of bias (13.3%), 20 had a moderate risk of bias (66.7%), while six had a high risk of bias (20.0%)

### Prevalence of online NHPs purchase

The prevalence of online NHPs purchases ranged from 0% to 37.1% across 30 studies, with a pooled prevalence estimated at 7.60% (95% CI: 5.49, 10.01) (Fig. 2). As considerable heterogeneity was observed ( $I^2 = 98.2\%$ ,  $p < 0.001$ ), the use of random-model effects was thus justified. Possible sources of heterogeneity were explored by performing subgroup analyses (Table II). However, heterogeneity did not appear to be lower within subgroups, except for the pregnant woman ( $I^2 = 0\%$ ,  $p = 0.35$ ) and student subgroups ( $I^2 = 0\%$ ,  $p = 0.51$ ). Due to the small number of studies contributed in these subgroups (two studies in each subgroup), this finding ought to be interpreted with caution.

### Subgroup analyses

Studies undertaken between 2016 to 2020 demonstrated a higher prevalence of online NHPs purchase among the overall population (9.48% [95% CI: 6.40, 13.08]) than those conducted earlier (5.57% [95% CI: 2.52, 9.70]) (Table II). When considering different populations, online NHPs purchase was more prevalent among the

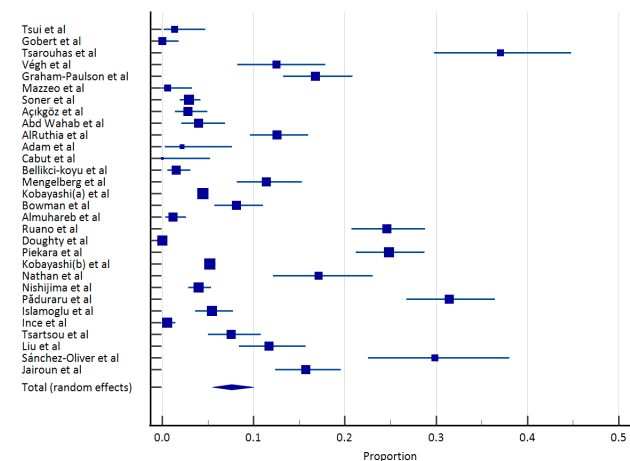
**Table 1: Characteristics of selected studies (sorted by inception year of study)**

Study ID	Country (Continent)	Inception year of study	Study design, setting	Population	Inclusion of sports nutrition in NHPs	Method of measurement	Sample Size	NHPs User	Online NHPs purchase		Risk of bias
									Event	Prevalence [95% CI] (%)	
1. Tsui B <i>et al</i> <sup>45</sup>	California (Northern America)	1999	Cross-sectional, academic medical facility	Pregnant woman	No	Questionnaire	150	20	2	1.33 [0.16, 4.73]	High
2. Gobert <i>et al</i> <sup>43</sup>	Canada (Northern America)	2005 <sup>†</sup>	Cross-sectional, community	Patient (Type 2 diabetes)	No	Questionnaire	200	145	0 <sup>†</sup>	0.00 [0.00, 1.83]	High
3. Tsarouhas <i>et al</i> <sup>31</sup>	Greece (Europe)	2008 <sup>†</sup>	Cross-sectional, gym	Athlete (Recreational adolescent athlete)	Yes	Questionnaire	170	100	63	37.06 [29.79, 44.79]	Moderate
4. Vigh <i>et al</i> <sup>33</sup>	Hungary (Europe)	2011	Cross-sectional, hospital	Patient (Outpatient)	No	Interview	200	171	25 <sup>†</sup>	12.50 [8.26, 17.90]	High
5. Graham-Paulson <i>et al</i> <sup>47</sup>	UK, Canada, USA, Germany, Switzerland, (Multi-national)	2012	Cross-sectional, athletic training/ competition	Athlete (physical/ visually impaired)	Yes	Questionnaire	399	232	67	16.79 [13.26, 20.83]	Moderate
6. Mazzeo <i>et al</i> <sup>25</sup>	Italy (Europe)	2012	Cross-sectional, sport's club	Athlete (Competitor & non-competitor boxer)	Yes	Questionnaire	169	117	1	0.59 [0.02, 3.25]	Moderate
7. Soner <i>et al</i> <sup>30</sup>	Turkey (Europe)	2012	Cross-sectional, hospital	Patient (Inpatient and outpatient)	No	Structured interview	927	452	27	2.91 [1.93, 4.21]	Moderate
8. Açikguz <i>et al</i> <sup>18</sup>	Turkey (Europe)	2013	Cross-sectional, hospital	Patient (Cardiology)	No	Questionnaire	390	116	11	2.82 [1.42, 4.99]	Low
9. Abd Wahab <i>et al</i> <sup>34</sup>	Malaysia (Asia)	2014 <sup>†</sup>	Cross-sectional, community	General public	No	Questionnaire	300	168	12	4.00 [2.08, 6.88]	Moderate
10. AlRuthia <i>et al</i> <sup>41</sup>	Saudi Arabia (Middle East)	2015	Cross-sectional, fitness centre	Fitness centre member (Male)	Yes	Structured interview	445	198	56	12.58 [9.65, 16.03]	Moderate
11. Adam <i>et al</i> <sup>19</sup>	Poland (Europe)	2015	Cross-sectional, oncology centre	Patient (Oncology)	No	Survey <sup>^</sup>	92	75	2	2.17 [0.26, 7.63]	High
12. Cabut <i>et al</i> <sup>22</sup>	France (Europe)	2015	Cross-sectional, pharmacy & clinic	Pregnant woman	No	Questionnaire	68	15	0	0.00 [0.00, 5.28]	Moderate
13. Bellikci-koyu <i>et al</i> <sup>20</sup>	Turkey (Europe)	2015	Cross-sectional, hospital	Patient (Overweight/ obese)	No	Structured interview	464	112	7	1.51 [0.61, 3.08]	Moderate
14. Mengelberg <i>et al</i> <sup>46</sup>	New Zealand (Oceania)	2015	Cross-sectional, community	General public	No	Questionnaire	334	296	38	10.98 [7.89, 14.76]	Moderate
15. Kobayashi (a) <i>et al</i> <sup>37</sup>	Japan (Asia)	2016	Cross-sectional, community	Student (College)	No	Questionnaire	9066	2060	404	4.46 [4.04, 4.90]	Moderate
16. Bowman <i>et al</i> <sup>21</sup>	Malta (Europe)	2017	Cross-sectional, community	General public	No	Questionnaire	444	NR	36 <sup>†</sup>	8.11 [5.74, 11.05]	Low
17. Almuhabeb <i>et al</i> <sup>40</sup>	Saudi Arabia (Middle East)	2017	Cross-sectional, hospital	Patient (Rheumatoid arthritis)	No	Structured interview	438	292	5	1.14 [0.37, 2.64]	Moderate
18. Ruano <i>et al</i> <sup>28</sup>	Portugal (Europe)	2017 <sup>†</sup>	Cross-sectional, gym association	Fitness centre member	Yes	Questionnaire	459	201	113	24.62 [20.74, 28.83]	Moderate
19. Doughty <i>et al</i> <sup>35</sup>	Singapore (Asia)	2017	Cross-sectional, community	General public (Chinese)	No	Questionnaire & structured interview	2294	438	0	0.00 [0.00, 0.16]	Moderate
20. Piekara <i>et al</i> <sup>27</sup>	Poland (Europe)	2017	Cross-sectional, Poland	Caregiver of children (Parents or caregiver)	No	Questionnaire	532	292	132 <sup>#</sup>	24.81 [21.20, 28.71]	Moderate
21. Kobayashi (b) <i>et al</i> <sup>36</sup>	Japan (Asia)	2017	Cross-sectional, community	Caregiver of children (Mother whose children use(d) NHPs)	No	Questionnaire	19,041	2439	990	5.20 [4.89, 5.52]	Moderate

**Table I: Characteristics of selected studies (sorted by inception year of study) (Continued)**

Study ID	Country (Continent)	Inception year of study	Study design, setting	Population	Inclusion of sports nutrition in NHPs	Method of measurement	Sample Size	NHPs User	Online NHPs purchase		Risk of bias
									Event	Prevalence [95% CI] (%)	
22. Nathan JP <i>et al</i> <sup>44</sup>	USA (Northern America)	2017	Cross-sectional, pharmacy and community	General public	No	Structured interview	199	139	34	17.09 [12.13, 23.05]	Moderate
23. Nishijima <i>et al</i> <sup>39</sup>	Japan (Asia)	2017	Cross-sectional, community	Student (High-school)	No	Questionnaire	1031	286	41 <sup>#</sup>	3.98 [2.87, 5.36]	Moderate
24. Păduraru <i>et al</i> <sup>26</sup>	Romania (Europe)	2018	Cross-sectional, community	Patient	No	Questionnaire	372	342	117	31.45 [26.76, 36.44]	High
25. Islamoglu <i>et al</i> <sup>24</sup>	Turkey (Europe)	2018	Cross-sectional, clinic	General patient (chronic disease)	No	Interview	516	244	28	5.43 [3.64, 7.75]	Low
26. Ince <i>et al</i> <sup>23</sup>	Turkey (Europe)	2018	Cross-sectional, hospital	Patient (chronic hepatitis B/C)	No	Structured interview	588	100	3	0.51 [0.11, 1.48]	High
27. Tsartsou <i>et al</i> <sup>32</sup>	Greece (Europe)	2019	Cross-sectional, community	General public	No	Questionnaire	358	150	27 <sup>#</sup>	7.54 [5.03, 10.78]	Moderate
28. Liu <i>et al</i> <sup>38</sup>	China (Asia)	2019	Cross-sectional, primary school	Caregiver of children (Parent/caregiver of school children)	No	Questionnaire	325	144 <sup>*</sup>	38	11.69 [8.41, 15.69]	Low
29. Sónchez-Oliver <i>et al</i> <sup>29</sup>	Spain (Europe)	2019	cross-sectional, university	Athlete (Rugby player)	Yes	Questionnaire	144	94	43	29.86 [22.53, 38.05]	Moderate
30. Jairoun <i>et al</i> <sup>42</sup>	United Arab Emirates (Middle East)	2020	Cross-sectional, community	Public	No	Questionnaire	420	NR	66	15.71 [12.37, 19.55]	Moderate

<sup>#</sup>Prevalence [95% CI], prevalence and 95% confidence interval of online NHPs purchase calculated from the number of event over the sample size; <sup>\*</sup>Clarified with author; <sup>\*</sup>Calculated or estimated from available data; <sup>#</sup>Exact tool of measurement not reported; <sup>\*</sup>Based on the total sample size of 706; NHPs, Natural health products; NR, Not reported



**Figure 2: Prevalence of online NHPs purchases among the overall population.** The x-axis extended from zero (no individual purchased NHPs over the Internet) to 0.5 (50% of individual purchased NHPs over the Internet). Individual prevalence was indicated (square) with the respective 95% CI (horizontal line), while the pooled prevalence calculated by random effect model was represented by the diamond.

fitness centre members (18.29% [95% CI: 8.13, 31.39]), athletes (17.95% [95% CI: 4.61, 37.45]), and children’s caregivers (12.87% [95% CI: 2.99, 28.23]) than the other subgroups. When sports nutrition was covered in the category of NHPs, the prevalence of online purchase

**Table II: Pooled prevalence of online NHPs purchase in different subgroups**

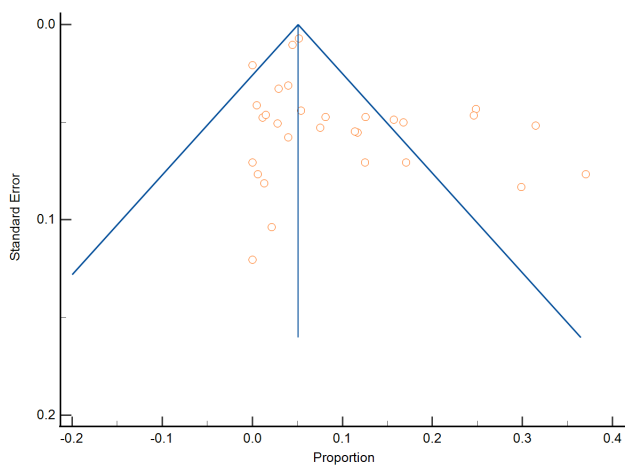
Subgroups	Number of study	Sample size	Prevalence [95% CI] (%)	Heterogeneity	
				I <sup>2</sup> (%)	p-value
<b>Year of study inception</b>					
1999-2015	14	4,308	5.57 [2.52, 9.70]	96.2	< 0.001
2016-2020	16	36,227	9.48 [6.40, 13.08]	98.8	< 0.001
<b>Population</b>					
Patient	10	4,187	4.18 [1.22, 8.81]	97.4	< 0.001
General public	7	4,349	7.67 [1.77, 17.20]	98.7	< 0.001
Caregiver of children	3	19,898	12.87 [2.99, 28.23]	99.0	< 0.001
Pregnant woman	2	218	1.14 [0.17, 2.97]	0.0	0.35
Student	2	10,097	4.42 [4.02, 4.83]	0.0	0.51
Athlete	4	882	17.95 [4.61, 37.45]	97.6	< 0.001
Fitness centre member	2	904	18.29 [8.13, 31.39]	95.5	< 0.001
<b>Types of product</b>					
NHPs without sports nutrition	24	38,749	5.67 [3.88, 7.76]	98.0	< 0.001
NHPs with sports nutrition	6	1,786	18.06 [9.30, 28.92]	96.6	< 0.001

CI, Confidence interval; NHPs, Natural health products.

(18.06% [95% CI: 9.30, 28.92]) was higher than those studies that did not include sports nutrition as part of NHPs (5.67% [95%CI: 3.88, 7.76]).

**Publication bias, sensitivity analysis and quality of evidence**

The funnel plot (Fig. 3) of the prevalence of online NHPs purchases did not suggest any evidence of publication bias (Egger’s test,  $p= 0.15$ ). When sensitivity analysis was conducted by excluding studies with a high risk of bias, the resulting pooled prevalence of online NHPs purchase was 8.23%, [95% CI: 5.96, 10.84]), which was higher than the main result (7.60%). Such marginal difference suggests that the main result was stable and not excessively influenced by those studies with a high risk of bias. Based on the GRADE assessment, the quality level of the pooled prevalence was downgraded from low to very low due to the presence of inconsistency across studies.



**Figure 3: : Funnel plot for the prevalence of online NHPs purchase in the overall population.**

**DISCUSSION**

This review shows that seven in 100 people had purchased NHPs over the Internet. Previous literature revealed that online purchase of NHPs is not as prevalent as other products, such as apparel and furniture (48). Such variation in prevalence could be associated with the product characteristics of NHPs, the quality of which could not be determined before purchase, unlike apparel and furniture (49). As a result, consumers are generally more hesitant to acquire this type of product over the Internet (50). However, the subgroup analysis revealed that online NHPs purchases have increased in recent years compared to previous years. This could be attributed to the advancing information technology and e-commerce ecosystem over the years that facilitate the growth of online purchase (51), as well as an ageing population seeking wellness and increasing interest towards natural substances (5). Nevertheless, NHPs are health-related product and its online sales should not be treated the same as the other fashion and hardware products. It is noteworthy that unmonitored and inappropriate NHPs use could result in adverse drug-supplement interaction or toxicity (52,53). This review calls for attention from the authorities in fostering stricter

and more regulated online NHPs sales to safeguard the public’s health.

The subgroup analyses showed that both fitness centre members and athletes marked the highest prevalence of online NHPs purchase than other subgroups of consumers. Both of these subgroups are physically active, and in addition to health purposes, they consume NHPs to accelerate physical recovery, improving athletic performance and muscle mass (28,54,55). As a result, they use a greater spectrum of NHPs, particularly including sports nutrition on top of vitamins and minerals. This may explain why the prevalence of online NHPs purchases is prominently higher when sports nutrition was included under the scope of NHPs. In the context of consumer’s safety, product authenticity is a common concern across all types of NHPs. Furthermore, sports nutrition has an additional risk of being adulterated with ergogenic and anabolic substances, due to its intended purpose to enhance physical performance (56). A study conducted in the Dutch market has reported that 38% of sports-related NHPs sampled online contained undeclared doping substances, ranging from stimulant, anabolic steroid, beta-2-agonist to beta-blocker (56). Given the higher prevalence of online NHPs purchases among physically active subgroups, the risk of acquiring adulterated NHPs from online purchases should be adequately conveyed to this community.

Following the physically active subgroups, online NHPs purchase was also common among child caregivers. NHPs that was commonly provided to children included vitamin C, probiotics/prebiotics, calcium and iron (27,36), aiming to improve the children’s overall health, immune system and bone health (57). Studies found that caregivers who consume NHPs are more likely to provide NHPs to their children (27,57), highlighting an important point that children’s NHPs use is primarily dependent on their caregiver’s decision. When NHPs is easily accessible to the caregivers through the e-commerce platforms, their capacity to make an informed and prudent NHPs selection for their children is critical. Moreover, some caregivers do not have proper guidance in NHPs selection (38,57), which necessitate more communication between healthcare professionals and caregivers, facilitating the conversation about the use of NHPs on their children, and serving as a credible reference point for the caregivers.

When comparing between types of products, a higher prevalence of online purchase was noted when sports nutrition was investigated along with other types of NHPs. This could be due to the study population involved, as studies including sports nutrition for exploration were conducted among physically active subgroups, notably athletes and fitness centre members, who have recorded a higher prevalence of online NHPs purchase than other populations. However, due to the lack of individual prevalence for online purchase of each NHPs type, this

review is unable to establish that the high prevalence of online NHPs purchase among physically active subgroups was influenced by the online sports nutrition purchase. This review consequently suggests that future studies investigating online NHPs purchases consider reporting individual prevalence statistics specific to each NHP type, to allow meaningful comparison between studies.

### Strength and Limitation

To the best knowledge of the researchers, this is the first systematic review reporting the pooled prevalence of online NHPs purchases for the general population. The meta-analysis covered a large number of respondents from studies that were mostly of low to moderate risk of bias, and no risk of publication bias was identified. However, high heterogeneity exists across the selected studies and remained unexplained by the subgroup analysis. This may be due to the vast and diverse spectrum of NHPs investigated across studies, as well as the unstandardized reporting time frame and instrument used to capture the activity of online NHPs purchase. Furthermore, the variables examined in the subgroup analyses may not encompass the variables impacting the prevalence of online NHPs purchases. Nevertheless, this review provides an insight into the magnitude of online NHPs purchase among the consumer, and a preliminary comparison of such activities across subgroups.

### CONCLUSION

The online purchase of NHPs occurred at the prevalence of 7.6%. Comparison between limited numbers of studies suggested that online NHPs purchase was more prevalent in recent years, among physically active populations and when sports nutrition was included within the scope of NHPs. However, a larger number of studies are required to be conclusive. A wide range of NHPs were investigated across studies, which may have contributed to the high heterogeneity reported in this review. It is recommended that future studies investigating online NHPs purchases consider reporting individual prevalence statistics specific to each NHPs type, to allow meaningful comparisons between studies.

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