

calories burned [21]. This mobile application is only presented in the studies [131 - 133], but there are no details given.

3.2.12. Carb Manager - Keto & Low Carb Diet Tracker

[31] allows the registration of age, physical activity level, gender, weight and height. In the diet section, it presents a food database with calories and allows the registration of diet diary with the indication of calories, macronutrient and fluid intake [31]. In the physical activity section, it will enable the listing of the physical log [31]. In a study [98] it has been referred that this mobile application is relevant for the tracking of patients with diabetes, but they found some issues.

Following the mobile applications categorized as “Physical activity”, Pedometer, Step Counter & *Weight Loss Tracker App* [27] allows the registration of age, physical activity level, gender, weight, height and goals, and the calculation of the body mass index. In the main page, it allows the monitoring of physical activity with the control of calories burned, challenges and gamification. In a study [134], the authors only described the features of this mobile application. In a study [135], it was reported to use for data acquisition.

3.2.13. Lose Weight In 21 Days - Home Fitness Workouts

[71] allows the creation of goals for weight loss, with the suggestion of training plan, gamification and reminders. This

mobile application has been presented in research [136], describing some features.

3.2.14. 7 Minute Workout - Weight Loss

[83], allows the registration of age, physical activity level, gender, weight and height. It allows the calculation of calories needed and basal metabolic rate. Furthermore , it suggests a training plan with videos. This mobile application is not validated, but it is presented in an investigation [137].

4. OTHER RESULTS

Based on the results presented in (Table 2), each mobile application has several features, where the number of functionalities defined for each mobile application varies between 1 and 27. Based on the number of features included, 16% of the mobile applications analyzed include only 1 feature, 11% of the mobile applications embed 2 features, 8% of the mobile applications examined include 6 or 11 features, 7% of the mobile applications explained present 3 or 9 features, and 5% of the mobile applications analyzed include 7 or 15 features. Moreover , 4% of the mobile applications examined include 12 or 19 features, and 3% of the mobile applications analyzed include 4, 8, 10, 13, 16 or 18 features. Finally, 1% of the mobile applications analyzed include 5, 14, 20, 21 or 27 features.

Table 2. Distribution by the number of features included.

| # Features | Mobile Applications |
|------------|--|
| 1 | [15], [18], [35], [40], [43], [50], [52], [63], [66], [68], [69] |
| 2 | [38], [42], [45], [48], [51], [57], [60], [73] |
| 3 | [20], [39], [49], [62], [71] |
| 4 | [37], [72] |
| 5 | [46] |
| 6 | [13], [44], [55], [59], [74], [81] |
| 7 | [30], [33], [58], [75] |
| 8 | [56], [83] |
| 9 | [27], [47], [54], [70], [76] |
| 10 | [31], [82] |
| 11 | [19], [21], [28], [29], [65], [77] |
| 12 | [17], [25], [53] |
| 13 | [22], [67] |
| 14 | [16] |
| 15 | [12], [24], [61], [80] |
| 16 | [41], [79] |
| 18 | [11], [64] |
| 19 | [14], [26], [36] |
| 20 | [23] |
| 21 | [78] |
| 27 | [34] |

In (Table 3) to 9, the features were distributed by the different mobile applications analyzed, where 64% of the mobile applications allow the registration of the weight and/or height, 53% allows the age and the gender, 44% allows the registration of goals, 36% allows the registration of diet diary, 34% presents a food database with calories and the calculation

of the calories needed, 33% presents a physical activity level, 30% measures the calories intake and burned, 29% allows the calculation of the BMI and has educational purposes, 26% allows the registration of the diet plan and registration of recipes, 25% allows the measurement of macronutrient intake and and exercise diary, 23% allows the registration of the fluid

intake, 22% allows the definitions the reminders, 18% allows the definition of the training plan, 15% allows the registration of the waist size, 12% allows measurement of the body fat, 11% allows the monitoring of the physical activity, 10% allows the registration of the shopping list, and the monitoring of physical activity with other mobile applications, 8% allows the registration of challenges, the calculation of the ideal weight and the basal metabolic rate, the registration of the hip size, 7% allows the registration of the food preferences and the breast size, 5% allows the measurement of the fluid needed, the monitoring of the sleep and the registration of the thigh size, 4% allows the registration of the size of neck, forearm, arm, shoulders and leg, 3% uses other devices, allows the registration blood pressure, medication diary, pulse, diabetic and/or allergies and shows videos to the user, and, finally, 1% allows the registration of caffeine intake, glycemic, smoker, mood and emotions, lean body mass, overweight tendency, pregnancy number, health questionnaire, pregnancy and body structure, the calculation of weight index and waist/height relation, the visualization of a food database with glycemic index and the diagnosis, presents questionnaires to the user and the possibility to gain points.

In total, the 82 mobile applications analyzed have different features classified into two groups, where one group contained the functions related to vital, anthropometric, medical and social parameters and another group that includes the purposes related to diet and physical activity data. Firstly, Table 3 contains the features distributed in the first group, where the most available features are the registration of age, gender, weight, height, reminders and goals, as well as the calculation of body mass index (BMI) and physical activity level, and the availability of an educational component. Finally, Table 4 contains the features distributed in the second group, where the most available features are the measurement of the calories, macronutrient and fluid intake, and calories needed, the registration of diet and exercise diaries, diet and training plans, and exercise diary, and the availability of food database with calories and recipes.

Globally, Fig. (2) shows the distribution of the features by the 82 mobile applications analyzed. The features available in

more than 20 mobile applications are the registration of weight, height, gender, age, diet diary, diet plan and goals, the measurement of calories needed, calories burned, physical activity level, body mass index (BMI) and calorie intake, and the availability of food database with calories and educational components.

Finally, the mobile applications available on the Google Play Store are rated by the users. (Table 5) synthesizes the relation between the number of reviews and the current user rating verified on 5th October 2019. Regarding the mobile applications rated with 4.0, 50% of them were rated by less than 1,000 users, 33% were rated by between 1,000 and 10,000 users, and 17% were rated by between 10,000 and 100,000 users. All mobile applications rated with 4.1 were rated by less than 1,000 users. Regarding the mobile applications rated with 4.2, 33% of them were rated by less than 1,000 users, 44% were rated by between 1,000 and 10,000 users, and 22% were rated by between 10,000 and 100,000 users. Of the mobile applications rated with 4.3, 20% were rated by less than 1,000 users, 50% were rated by between 1,000 and 10,000 users, 20% were rated by between 10,000 and 100,000 users, and 10% were rated by between 100,000 and 500,000 users. Concerning the mobile applications rated with 4.4, 22% of them were rated by less than 1,000 users, 56% were rated by between 1,000 and 10,000 users, 11% were rated by between 100,000 and 500,000 users, and 11% were rated by between 500,000 and 1,000,000 users. Of the mobile applications rated with 4.5, 33% were rated by less than 1,000 users, 13% were rated by between 1,000 and 10,000 users, 33% were rated by between 10,000 and 100,000 users, 13% were rated by between 100,000 and 500,000 users, and 7% were rated by more than 1,000,000 users. Of the mobile applications rated with 4.6, 8% were rated by less than 1,000 users, 67% were rated by between 10,000 and 100,000 users, and 25% were rated by between 100,000 and 500,000 users. Of the mobile applications rated with 4.7, 38% were rated by between 1,000 and 10,000 users, 13% were rated by between 10,000 and 100,000 users, 38% were rated by between 100,000 and 500,000 users, and 13% were rated by between 500,000 and 1,000,000 users. Of the mobile applications rated with 4.8, 50% were rated by between 1,000 and 10,000 users, and 50% were rated by between 10,000 and 100,000 users.

Table 3. Mobile applications with features related to vital, anthropometric, medical and social parameters.

| Features | Mobile applications |
|--------------------------|--|
| Age | [11], [12], [13], [16], [17], [19], [21], [22], [23], [24], [25], [27], [28], [29], [30], [31], [34], [36], [37], [41], [47], [53], [54], [56], [59], [61], [64], [65], [67], [70], [75], [76], [77], [78], [79], [80], [81], [82], [83] |
| Gender | [11], [12], [16], [17], [21], [22], [23], [24], [25], [27], [28], [30], [31], [34], [36], [37], [41], [46], [47], [53], [54], [55], [56], [59], [61], [64], [65], [67], [70], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83] |
| Weight/Height | [11], [12], [13], [14], [16], [17], [19], [20], [21], [22], [23], [24], [25], [27], [28], [29], [30], [31], [33], [34], [36], [37], [41], [44], [46], [47], [53], [54], [55], [56], [61], [62], [64], [65], [67], [70], [72], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83] |
| BMI | [11], [20], [22], [23], [24], [27], [29], [33], [34], [36], [37], [44], [46], [47], [53], [56], [64], [75], [78], [81], [82] |
| Body fat | [14], [24], [29], [34], [36], [47], [56], [79], [78] |
| Body lean | [34] |
| Waist-height relation | [47] |
| Ideal weight calculation | [23], [29], [34], [36], [61], [77] |
| Waist | [11], [23], [26], [34], [36], [61], [62], [76], [78], [79], [82] |
| Neck | [23], [36], [79] |

(Table 3) contd....

| Features | Mobile applications |
|-------------------------------------|--|
| Breast | [26], [36], [61], [76], [79], |
| Forearm | [26], [36], [79] |
| Arm | [26], [36], [79] |
| Shoulders | [26], [36], [79] |
| Leg | [26], [36], [79] |
| Hip | [34], [36], [61], [76], [79], [82] |
| Thigh | [23], [26], [36], [79] |
| Body structure | [36] |
| Physical activity level | [11], [12], [13], [16], [17], [19], [22], [23], [24], [25], [27], [28], [31], [34], [36], [41], [54], [59], [67], [70], [78], [80], [82], [83] |
| Mood and emotions | [61] |
| Sleep | [14], [34], [41], [64] |
| Education | [13], [14], [22], [29], [34], [35], [38], [42], [43], [44], [46], [47], [50], [54], [63], [64], [65], [68], [69], [72], [73] |
| Reminders | [22], [34], [41], [56], [58], [61], [64], [67], [71], [74], [76], [77], [78], [79], [80], [81] |
| Smoker | [65] |
| Goals | [11], [12], [14], [16], [17], [19], [21], [22], [23], [24], [25], [27], [28], [34], [36], [41], [53], [54], [58], [59], [61], [64], [67], [70], [72], [74], [77], [78], [79], [80], [81], [82] |
| Points | [71] |
| Blood pressure | [14], [82] |
| Pulse | [14], [34] |
| Medication diary | [14], [65] |
| Glycemic | [14] |
| Diabetic | [17], [65] |
| Allergies | [11], [65] |
| Health questionnaire | [65] |
| Diagnostic | [65] |
| Pregnancy | [65] |
| Registration of overweight tendency | [61] |
| Registration of pregnancy number | [61] |

Table 4. Mobile applications with features related to diet and physical activity data.

| Features | Mobile applications |
|-------------------------------------|--|
| Food database with calories | [11], [12], [13], [14], [15], [16], [18], [19], [21], [23], [24], [25], [26], [29], [31], [34], [41], [53], [54], [55], [64], [67], [77], [78], [80] |
| Food database with a glycemic index | [72] |
| Calories intake | [11], [12], [14], [16], [17], [19], [21], [23], [24], [25], [26], [31], [34], [41], [49], [53], [55], [64], [67], [70], [78], [80] |
| Macronutrients intake | [12], [14], [16], [19], [21], [23], [24], [25], [26], [31], [34], [41], [49], [53], [67], [70], [78], [80] |
| Fluid intake | [11], [12], [14], [17], [22], [23], [24], [25], [31], [34], [44], [48], [64], [75], [77], [78], [80] |
| Fluid needed calculation | [23], [24], [25], [64] |
| Diet diary | [11], [12], [14], [16], [17], [19], [21], [23], [24], [25], [26], [31], [34], [41], [44], [49], [53], [55], [61], [64], [67], [70], [75], [77], [78], [80] |
| Caffeine intake | [14] |
| Calories needed calculation | [11], [12], [13], [14], [16], [17], [19], [21], [22], [23], [24], [25], [26], [28], [29], [34], [36], [41], [53], [54], [64], [67], [78], [80], [83] |
| Basal metabolic rate | [23], [24], [34], [75], [82], [83] |
| Weight index calculation | [34] |
| Food preferences | [11], [28], [30], [33], [56] |
| Diet plan | [19], [20], [26], [29], [30], [138], [33], [38], [39], [46], [47], [48], [56], [57], [58], [61], [62], [64], [66], |
| Recipes | [26], [39], [40], [41], [42], [45], [47], [51], [52], [54], [55], [57], [58], [59], [60], [61], [64], [65], [73] |
| Shopping list | [26], [30], [33], [39], [45], [51], [60], |
| Questionnaire | [11] |

(Table 4) contd.....

| Features | Mobile applications |
|---|--|
| Calories burned | [11], [12], [14], [16], [17], [21], [22], [23], [26], [27], [28], [33], [34], [41], [53], [58], [64], [67], [74], [76], [78], [80] |
| Physical activity monitoring | [12], [14], [17], [26], [27], [34], [58], [74] |
| Exercise diary | [11], [12], [16], [21], [22], [23], [26], [28], [31], [34], [41], [53], [64], [67], [70], [77], [78], [80] |
| Challenges | [16], [19], [22], [27], [34], [78] |
| Videos | [78], [83] |
| Training plan | [14], [28], [29], [30], [33], [44], [58], [59], [71], [76], [78], [79], [83] |
| Devices | [12], [26] |
| Physical activity monitoring with another mobile applications | [11], [16], [28], [41], [77], [78], [80] |

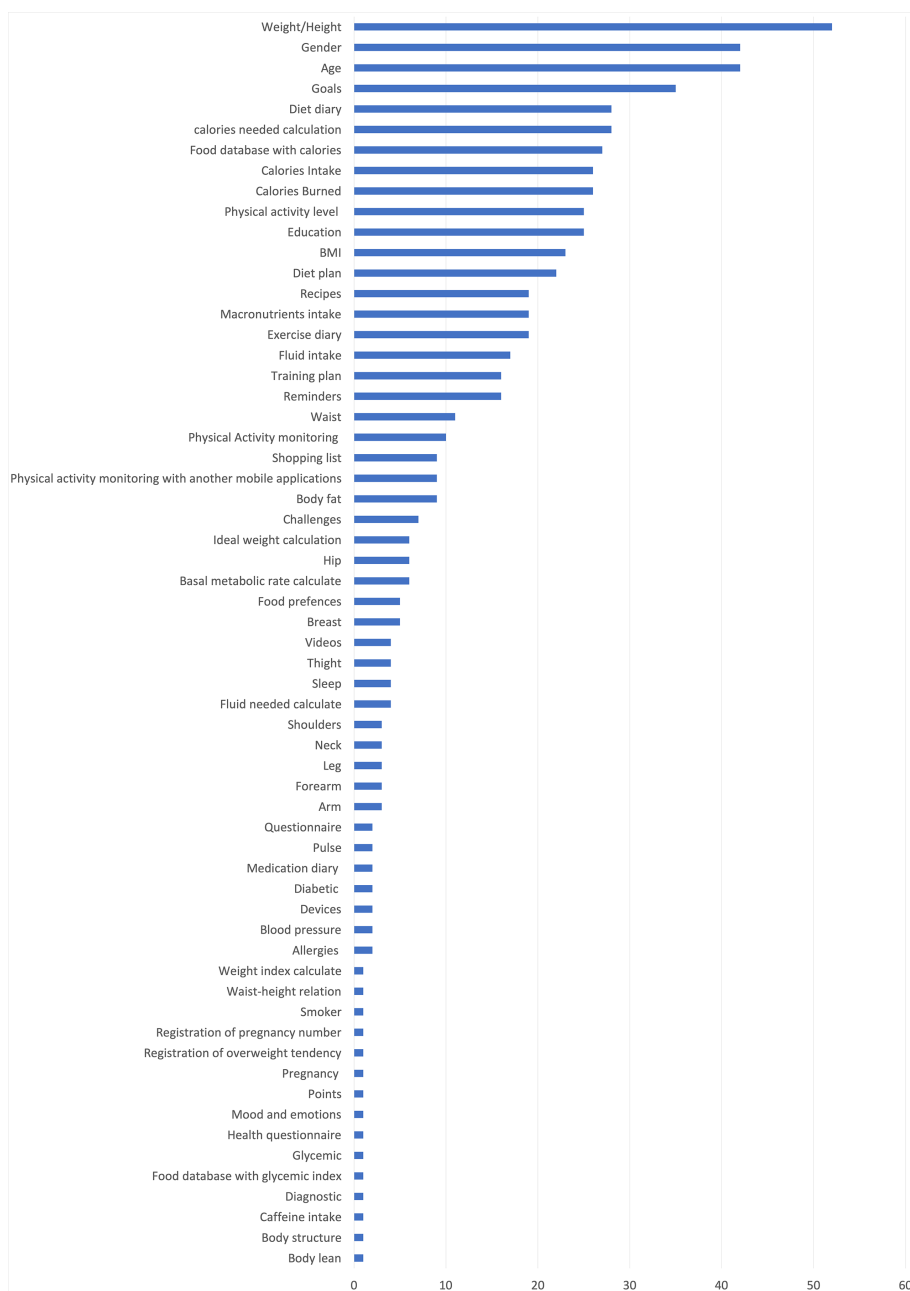


Fig. (2). Distribution of the features by the mobile applications.

5. DISCUSSION

Regarding (Table 6), the synthesis of other reviews available in the literature that matches our analysis is presented, verifying that the maximum number of analyzed mobile applications is 80 and the major part of them is related to health and fitness.

Based on the literature, there are other reviews about the same subject, but they are less detailed and with a smaller set of mobile applications than our review. In summary, this review analyzed 73 mobile applications related to nutrition, physical activity and health, which is a similar number of mobile applications analyzed in a study [109], but some of them were already removed from the Google Play Store. In (Table 5), eight literature reviews with a similar methodology of this paper have been summarized, verifying that the highest number of mobile applications examined is 80, but some of them were already removed from the online application stores. As presented in Fig. (3), the mobile applications that are the most analyzed are *Calorie Counter- MyFitnessPal*, which was explained in all literature reviews, and *Calorie Counter by FatSecret* and *Lose It! - Calorie Counter*, which was analyzed in 5 literature reviews. Regarding the literature reviews

analyzed, a review [98] examined the most number of mobile applications discussed in our report, in a total of 9. Secondly, Franco *et al.* [86] analyzed seven mobile applications available in our study. On the other hand, our review examined 80% of the mobile applications explained by the authors [88], 54% of the mobile applications analyzed by the authors of a study [86] and 21% of the mobile applications examined by the authors of another research [98]. In addition, 20% of the mobile applications analyzed in a study [139], 14% of the mobile applications explained in an investigation [124], 13% of the mobile applications analyzed by the authors of another study [121], 10% of the mobile applications examined by the authors of an analysis [104] and 5% of the mobile applications analyzed by the authors in a study [109].

The number of mobile applications analyzed in a report [109] is similar to the number of mobile applications explained in our review, examining 80 mobile applications, but only four of the mobile applications analyzed by the authors are the same as in this review. The main reason was related to the subject of the research, where the authors [109] studied the mobile applications more focused on health, where our review is more concentrated in nutrition and physical activity.

Table 5. Distribution of the rating of mobile applications.

| Number of reviews | User Rating | | | | | | | | |
|---------------------|------------------|------------|------------------------|------------------------------|------------------------------|------------------------------|--|------------------|------|
| | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 |
| < 1,000 | [42], [66], [73] | [38], [40] | [15], [57], [63] | [44], [50] | [39], [47] | [20], [35], [43], [68], [69] | [49] | - | - |
| 1,000 – 10,000 | [26], [61] | - | [32], [34], [54], [56] | [13], [45], [70], [72], [78] | [24], [46], [79], [81], [82] | [25], [52] | - | [60], [62], [76] | [51] |
| 10,000 – 100,000 | [17] | - | [55], [67] | [29], [59] | - | [19], [21], [31], [48], [64] | [18], [23], [30], [37], [53], [58], [75], [80] | [71] | [83] |
| 100,000 – 500,000 | - | - | - | [11] | [77] | [16], [28] | [22], [36], [74] | [33], [41], [65] | - |
| 500,000 – 1,000,000 | - | - | - | - | [14] | - | - | [27] | - |
| > 1,000,000 | - | - | - | - | - | [12] | - | - | - |

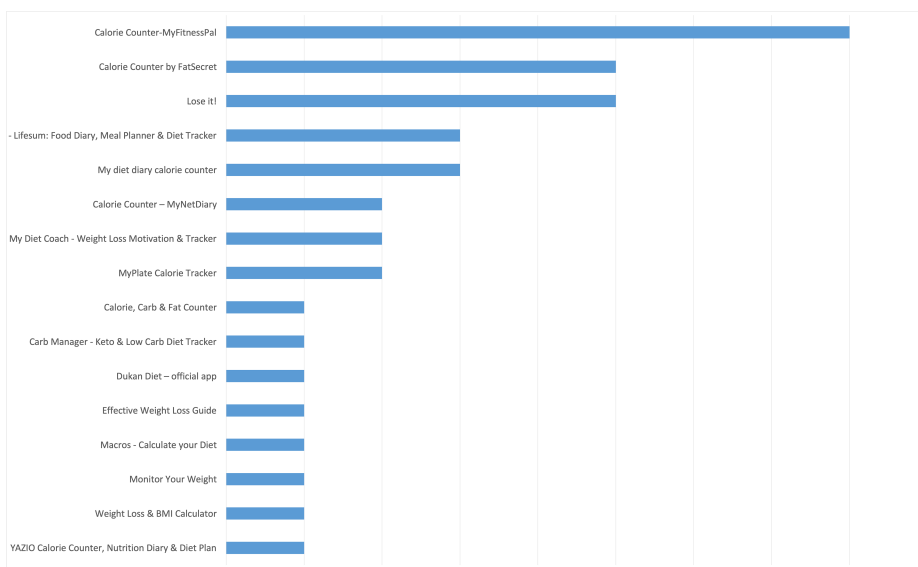


Fig. (3). Ranking of the mobile application presented in studies.

In a study [104], the authors analyzed 40 mobile applications, but our review only explained 10% of them, because they examined only the most popular mobile applications in the Mobile Health subject. On the other hand, the study [121] presented the analysis of 30 mobile applications, and they analyzed 13% of the mobile applications examined in our review because they explained the mobile applications for Android and iOS operating systems. About the Android operating system, the study [121] only analyzed the mobile applications available in the top 100 of the Google Play Store.

Following the user rating of the mobile applications analyzed, the mobile applications only reviewed by less than 1,000 users (*i.e.*, 25% of the mobile applications analyzed) are the less relevant, where the user rating is not very relevant. The mobile applications analyzed by more than 1,000 users corresponds to the major part (*i.e.*, 75% of the mobile applications analyzed) of the mobile applications analyzed. Thus, 30% of the mobile applications are analyzed by between 1,000 and 10,000 users, 20% of the mobile applications are analyzed by between 10,000 and 100,000 users, 10% of the mobile applications are analyzed by between 100,000 and 500,000 users, and only 5% of the mobile applications are analyzed by more than 500,000 users. Considering that the rating of the mobile applications reviewed by a number of users higher than 1,000 users is relevant, 54 of the mobile applications analyzed (75%) may be evaluated by the user rating.

Following the results, a taxonomy for the mobile applications analyzed in this study has been proposed, which, as presented in Fig. (4), is composed of four categories, namely “Education”, “Diet and nutrition”, “Physical activity” and “Health”.

Following the results of other reviews and the analyses of different mobile applications, two taxonomies have been proposed, one of them is related to the goals of the mobile applications (Fig. 4) and other associated with the categorization of the functionalities of these mobile applications

analyzed (Fig. 5).

Based on the features available in the different mobile applications analyzed, it can be classified into four groups, including “Education”, “Diet and nutrition”, “Physical activity” and “Health”. The mobile applications included in the “Education” category consists of the mobile applications related to the teaching of some concepts related to the information available in the literature or shared by different people. Another important category is related to “Diet and nutrition”, where these mobile applications are mainly related to healthy nutrition habits. Next, the “Physical activity” category is related to different mobile applications related to the measurement of the different parameters related to physical activity. Finally, the “Health” category includes the mobile applications related to all concepts focused on this paper, such as diet, nutrition, physical activity and medical concepts.

Following the mobile applications analyzed in other reviews, nine mobile applications are categorized in “Health”, six mobile applications are classified in “Diet and Nutrition”, and one mobile application is categorized in “Health”. However, our review found more mobile applications in “Diet and Nutrition”, but the other studies in the literature have more applications related to “Health” available in our review.

In Fig. (5), a taxonomy related to the functionalities found in the mobile applications examined has been proposed, composed by “Diet”, “Anthropometric parameters”, “Social”, “Physical activity”, “Medical parameters” and “Vital parameters”. The categories with more functionalities are “Anthropometric parameters” and “Diet”.

Also, Table 7 presents the categorization of the mobile applications analyzed in this review by the functionalities of their features, where it is verified that the category with more mobile applications is "Diet" with 60 mobile applications (82%). Next, the category "Social" has 53 mobile applications (73%), and the class "Anthropometric parameters" have 49 mobile applications (67%). The mobile applications include several features, and they can be included in more than one category.

Table 6. Summary of the studies that present other literature reviews.

| Study | Year of Publication | Number of Mobile Applications Analyzed | Number of Mobile Applications Also Examined in this Study | Mobiles Applications in Common | Search Criteria | Purpose of the Study |
|---------------------------|---------------------|--|---|--|---|---|
| Franco <i>et al.</i> [86] | 2016 | 13 | 7 | [12], [41], [22], [21], [17], [29], [19] | Calories; Diet; Diet tracker; Dietician; Dietitian; Eating; Fit; Fitness; Food; Food diary; Food tracker; Health; Lose weight; Nutrition; Nutritionist; Weight; Weight loss; Weight management; Weight watcher; Weight watcher calculator | Analysis of mobile applications related to nutrition purposes |

(Table 6) contd.....

| Study | Year of Publication | Number of Mobile Applications Analysed | Number of Mobile Applications Also Examined in this Study | Mobiles Applications in Common | Search Criteria | Purpose of the Study |
|------------------------------|---------------------|--|---|--|--|---|
| Darby <i>et al.</i> [98] | 2016 | 42 | 9 | [31], [41], [11], [21], [24], [22], [12], [23], [16] | Diet; Eating; Food; Food diary; Health; Nutrition; Nutrition diary; Nutrition tracking | Analysis of nutritional tracking applications that should be the first recommendations to diabetes patients |
| Chen <i>et al.</i> [124] | 2015 | 28 | 4 | [80], [12], [17], [41] | Health and fitness | Evaluation of the quality of most popular dietary weight-loss mobile applications |
| Azar <i>et al.</i> [139] | 2013 | 10 | 2 | [21], [12] | Health and Fitness | Evaluation of the diet/nutrition and anthropometric tracking mobile applications |
| Pagoto <i>et al.</i> [121] | 2013 | 30 | 4 | [23], [12], [41], [21] | Health and fitness | Analysis of weight-loss mobile applications |
| Griffiths <i>et al.</i> [88] | 2018 | 5 | 4 | [12], [21], [80], [11] | Health and fitness Nutrition | Assessment of the accuracy of nutrient intake calculations performed by mobile applications |
| Mea <i>et al.</i> [109] | 2015 | 80 | 4 | [61], [37], [12], [36] | Medical Health and Fitness | Classification of mobile applications and medical devices |
| Azfar <i>et al.</i> [104] | 2015 | 40 | 4 | [12], [41], [17], [11] | mHealth | Propose a forensic taxonomy for mobile applications |

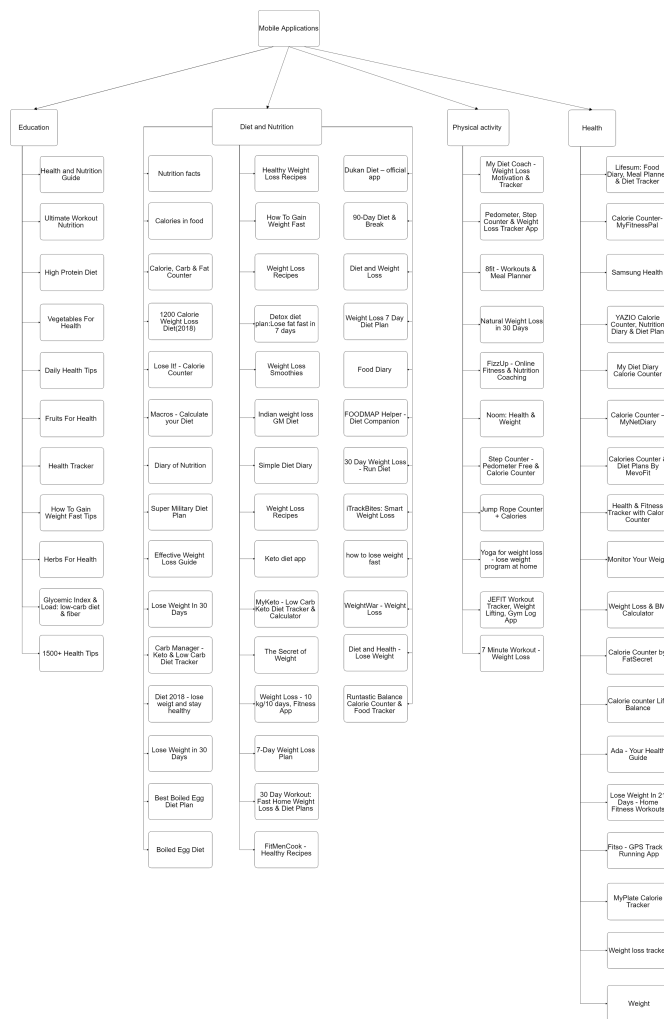


Fig. (4). Taxonomy for the mobile applications analyzed in this study.

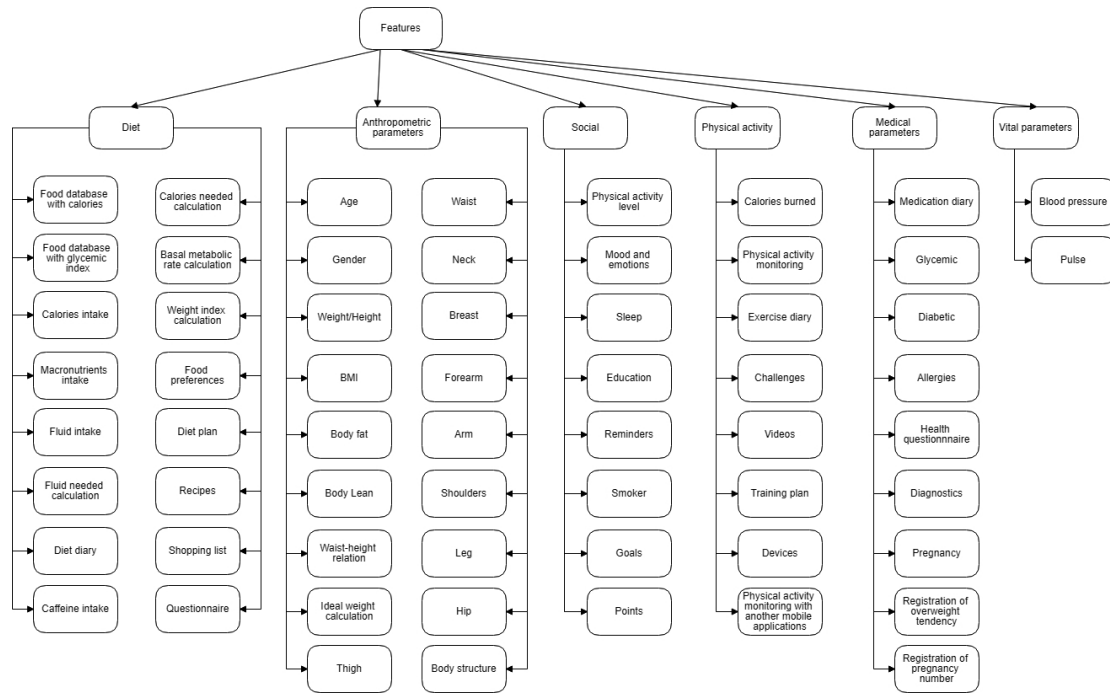


Fig. (5). Taxonomy for the features of the mobile applications analyzed in this study.

Table 7. Distribution of mobile applications by categories of features.

| Categories | Mobile Applications |
|---------------------------|--|
| Diet | [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21] [22], [23], [24], [25], [26], [28], , [29], [30], [31], [138], [33], [34], [36], [38], [39], [40], [41], [42], [44], [45], [46], [47], [48], [49], [51], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61], [62], [64], [66], [67], [70], [72], [73], [75], [77], [78], [80], [82], [83] |
| Anthropometric parameters | [11], [12], [13], [14], [16], [17], [19], [20], [21] [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [33], [34], [36], [37], [41], [46], [47], [53], [54], [55], [56], [59], [61], [62], [64], [65], [67], [70], [72], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83] |
| Social | [11], [12], [13], [14], [16], [17], [19], [21] [22], [23], [24], [25], [27], [28], [29], [31], [34], [35], [36], [38], [41], [42], [43], [44], [46], [47], [50], [53], [54], [56], [58], [59], [61], [63], [64], [65], [67], [68], [69], [70], [71], [72], [73], [74], [76], [77], [78], [79], [80], [81], [82], [83] |
| Physical activity | [11], [12], [14], [16], [17], [19], [21] [22], [23], [26], [27], [28], [29], [30], [31], [33], [34], [41], [44], [53], [58], [59], [64], [67], [70], [71], [74], [76], [77], [78], [79], [80], [83] |
| Medical parameters | [11], [14], [17], [61], [65], [82] |
| Vital parameters | [14], [34] |

CONCLUSION

This review identified and described the mobile applications related to health, nutrition and physical activity. Eighty-two mobile applications were analyzed, and the main findings are as follows :

- (RQ1) There are several mobile applications related to physical activity, diet, nutrition and health purposes, resulting in the analysis of 73 mobile applications available on the Google Play Store. The mobile applications analyzed are mainly related to diet and nutrition, including *Lose it! – Calorie Counter*, *Calorie, Carb & Fat Counter* [21], *1200 Calorie Weight Loss Diet(2018)* [20], *Macros - Calculate your Diet* [24], *MyKeto - Low Carb Keto Diet Tracker & Calculator* [54], and *iTrackBites: Smart Weight Loss* [70].
- (RQ2) There are only 19 mobile applications referenced in scientific studies, where experimental validation is rarely verified. In the major part of the studies, the mobile applications are only referred, but it lacks the analysis and validation of them.
- (RQ3) The essential features available in the mobile applications analyzed are Weight/height, Age, Gender, Goals, Calculation of Calories needed, Diet diary, Food database with calories, calories burned, calorie intake and others.
- (RQ4) The features available in the mobile applications analyzed can be classified into six groups, such as diet, anthropometric parameters, social, physical activity, medical parameters and vital parameters. Additionally, mobile applications analyzed can be grouped into four categories, such as education, diet and nutrition, physical exercise, and health.

Furthermore, this review highlights the mobile applications related to “nutrition”, “diet”, “calories”, “health”, “exercise” and “weight”, where the download and registration are free, the user rating and the number of downloads are high. The mobile applications with the focus to pregnancy, children and pets are excluded, as well as games, and mobile applications for hypnosis for weight loss or a specific pathology are also excluded. Finally, only the mobile applications available in English were included.

Of the analyzed mobile applications, 52% are related to “Diet and nutrition”, 25% are related to “Health”, 11% are related to “Education”, and 12% are related to “Physical activity”.

This study was performed to investigate the functionalities of the mobile applications available on the Google Play Store for nutrition and physical activity. As future work, it is required to develop and analyze a mobile application for teenagers to promote healthy lifestyles.

CONSENT FOR PUBLICATION

Not applicable.

STANDARD OF REPORTING

PRISMA Guideline and methodology were followed.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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